SEPT. 50

Radio-Electronics

ELEVISION · SERVICING · HIGH FIDELITY

A GERNSBACK PUBLICATION

GO GERNSBACK, Editor-in-chief

Better Transistor Ignition

Shooting Sweep and Sync Trouble

How to Use the Q-Meter

Superselective Adap

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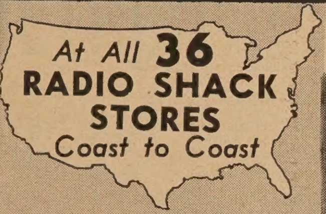

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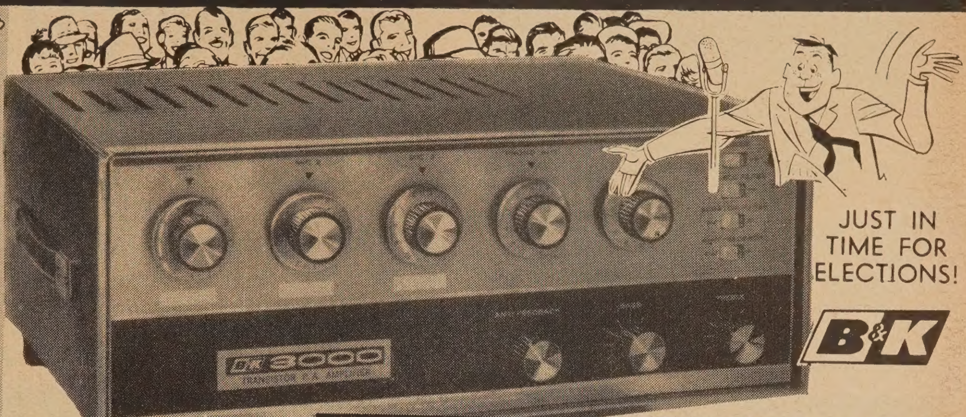

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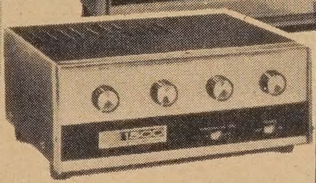

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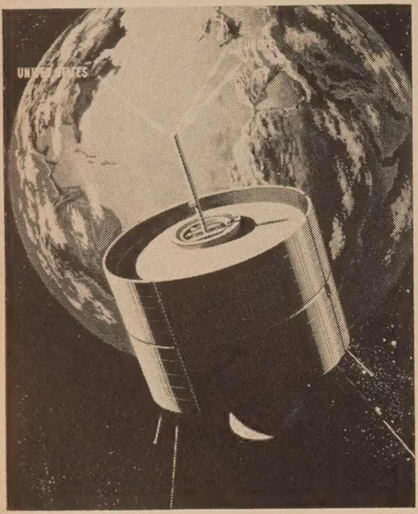


Model of "public satellite No. 1" as it might appear to a viewer in space, looking past it towards its "service area."

TRANSOCEANIC TV BY '65?

Trans-Atlantic telephone calls and live TV programs will be a reality in 1965, according to Dr. Allen E. Puckett, vice president of Hughes Aircraft Co. These will be possible with the help of "Public Satellite No. 1," now being built for Communications Satellite Corp.

The statement was made at a recent meeting of the American Institute of Aeronautics & Astronautics in Washington, at which a full-scale model of the satellite was displayed.

The new satellite, Early Bird, will be launched in synchronous orbit, hovering 22,300 miles above earth. It will take a position between North America and Europe, and it will be able to carry 240 two-way telephone calls simultaneously or an equivalent number of TV broadcasts or a combination of various forms of communication.

LASER DRILLS NOW USEFUL

A practical application for the laser's well known ability to drill holes through hard metal (such as razor blades) has been announced by RCA's Aerospace Systems Div. in Burlington, Mass. The new laser drill has made holes as small as one ten-thousandth inch in diameter in tungsten wire. These holes are invisible to the naked eye.

Burton Clay, project engineer for the device, says this unique application can lead to extremely compact and fast micro-energy units for computers. Compactness and low electrical-energy requirements in computer memories depends on drilling holes very close to each other in magnetic wire. The smaller the holes, the closer together they can be drilled.

Mechanical drills have been made as small as one-hundredth inch in diameter and electron-beam drills can make still smaller holes, but heating of the metal makes both methods impractical. The laser drill goes through "in a millionth of a second, so fast the surrounding material never gets a chance to heat up," Clay pointed out.

VIDEO TAPE RECORDER TO HAVE 30 TRACKS

The new tape recorder being developed at the Illinois Institute of Technology will have 30 parallel longitudinal tracks on standard ¼-inch audio tape, recording pioneer Marvin Camras told delegates to the IEEE Chicago Spring Conference on broadcast and TV receivers.

The 30 tracks are in three sets of 10 tracks each, Camras told his audience. Seven-inch reels of audio tape will be used for 60 minutes of recording or playback. Speed is 120 ips, and the picture bandwidth is expected to be about 2.5 mc. Cost will be not higher than $500, Camras believes.

STRATEGIC AIR COMMAND GETS NEW NERVE SYSTEM

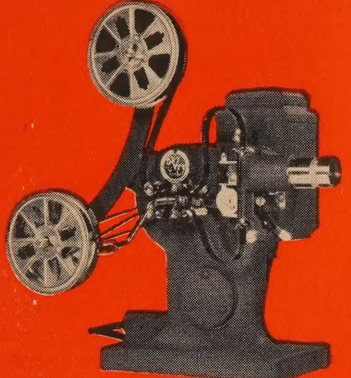
The major elements of the Strategic Air Command's new Command Control System (Project 465L) were displayed at a press conference at the ITT Data & Information Systems Div. in Paramus, N.J. The equipment is now being phased into SAC's underground control center at Offutt Air Force Base near Omaha.

The system is fed by numerous stations at Air Force bases around the country. Information on weather, bombers, missiles, tankers, personnel and other pertinent subjects is fed in by a message composer that converts standard messages into computer data. These are forwarded to the central computer at Offutt AFB, and processed.

The results are displayed on a special type of large wall display. Information is printed out on a 70-millimeter transparent film. Images of each message appear on the film, which is then projected by a projector with three sets of color lenses, so adjusted that the three images register on the screen. One lens is red, one blue, and one green. If all three images of the message are printed on the film, the three colored projected images register to make a white display. If only one image is printed, the areas before the other two lenses are made opaque, and only one color is projected on the screen.

By using one, two and three colors, seven distinct colors can be displayed, making it possible to present graphic charts, maps, etc. of much greater complexity than can be done in black and white. Printed data can also be emphasized and tabulated by the use of color.

A prototype display board at Paramus shows the variety of material that can be shown in seven colors.



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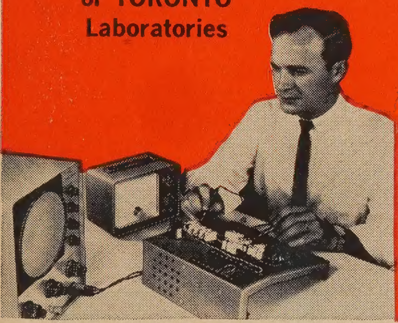

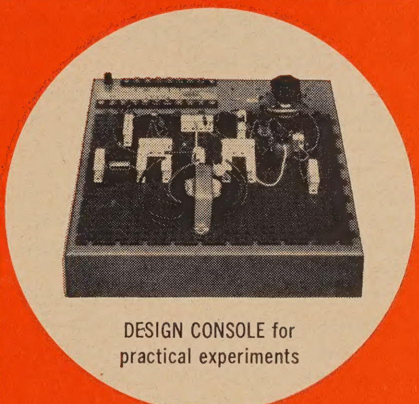

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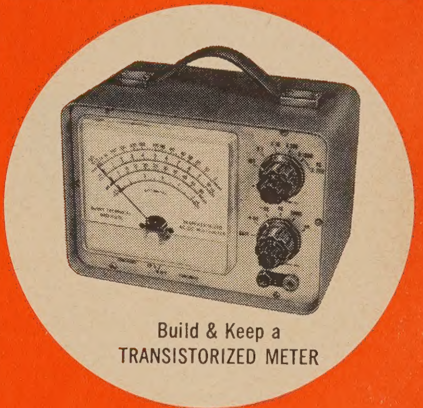

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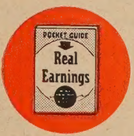

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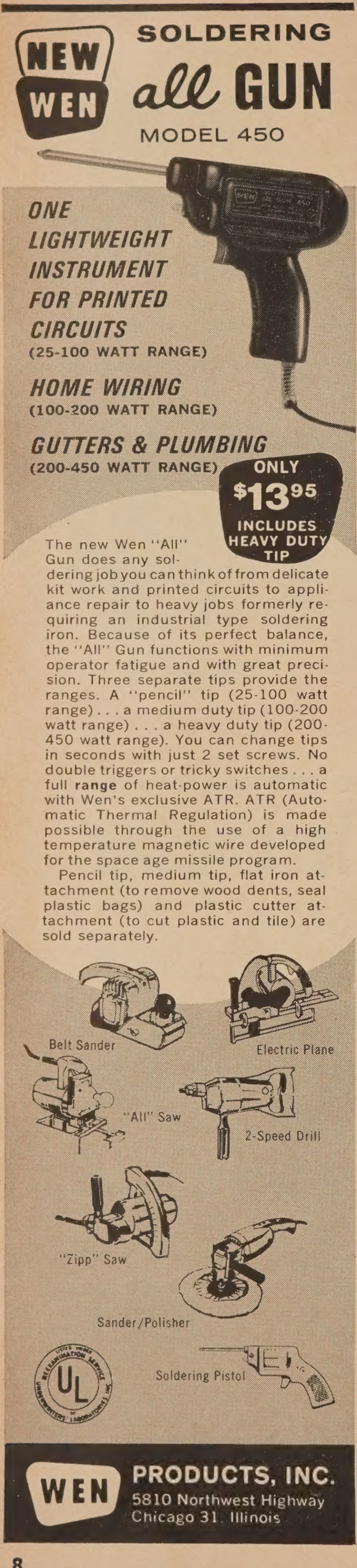
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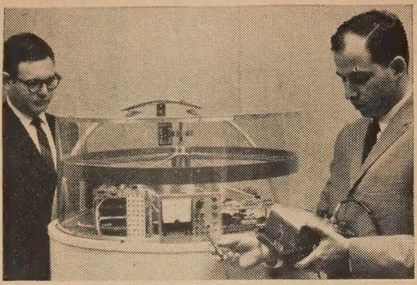

Project Director, Harold Perkel (left) and Dr. Robert Scher checking out a laboratory model of "Stabilite," the device that controls rocking, turning and twisting motions of an orbiting spacecraft.

NEW STABILIZING SYSTEM KEEPS SATELLITES RIGHT

A new way of keeping satellites pointed in the desired direction has been announced by RCA's Astro-Electronics Div., Princeton, N.J. The new *Stabilite* has a coil through which current can be passed to form a magnetic field around the satellite, and a flywheel which controls the satellite's spin.

The magnetic field created around the satellite tends to line it up with that of the earth, while the flywheel controls rocking motion. Thus the Stabilite could keep the antenna of a communications satellite pointed continuously toward ground stations, or keep the telescope of an astronomical satellite pointed at a desired star or planet.

TINYVISION—IN ALL SIZES

The tinyvision size race is galloping in both directions, reports *Television Digest*. Americans, thinking big, will have mammoth-size tinyvision with a 13-inch screen as well as the large 12-inch and the family 11-inch sizes. The Japanese, thinking small, are heading toward the vanishing point with 4- and 3-inch sets. The new 13-inch tube size, developed by Lancaster Glass Co., will appear on one of the American sets this fall.

In the 11- and 12-inch sets we have Admiral, DuMont, Emerson, Magnavoz, Curtis Mathes, Westinghouse, Zenith, Sears and Montgomery Ward. The mail-order houses and some of the standard brands are marketing Japanese-made sets. General Electric and Philco have announced 9-inch receivers. Mitsubishi expects to put a 6-inch color set on the market at some unannounced date. Sony has a 4-inch transistorized set, and Standard Radio a "Micro Miniaturized TV" with a 3-inch screen. The whole set is less than 3 inches high, 7 wide and 7 deep.

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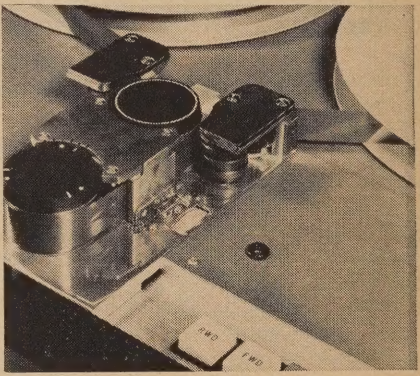
NEW TAPE SYSTEM UPS FIDELITY

A new recorder that produces professional master tapes was described and demonstrated by 3M recently.

In a simplified description, 3M engineer John T. Mullin explained that the device was intended to give a better signal-to-noise ratio and loud but undistorted tones without introducing noise from the machine.



The tape transport mechanism of 3M's new professional mastering recorder.

This is done by recording on two tracks. One track of each channel records in the usual way; the other track is specially equalized to record signals of small volume. In playback, low-level signals are reproduced from the special track. As volume increases to the point where the low-level track produces distortion of 1% at any frequency, the tape switches over electronically onto the conventional track. The switching takes place in 1 millisecond, so that even steep transients of high amplitudes are reproduced without audible distortion.

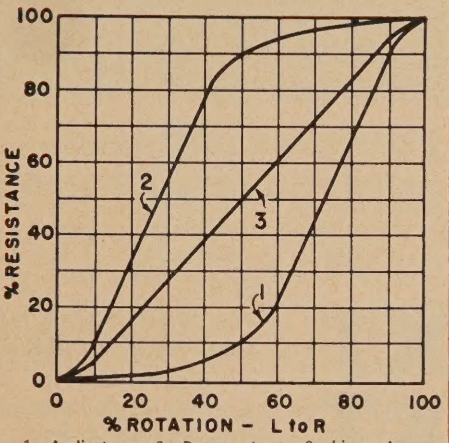
The new system improves the dynamic range of sound recording up to 15 decibels, Mr. Mullin stated. Another feature of the system is the 350-kc bias frequency, which completely eliminates beats and "birdies."

MALLORY

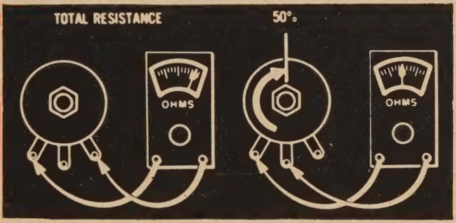
Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis, Ind. 46206
a division of P. R. Mallory & Co. Inc.

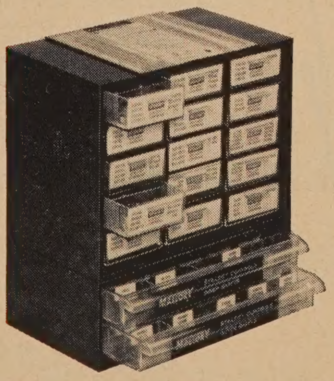
How to choose and use replacement controls



1—Audio taper. 2—Reverse taper. 3—Linear taper.



Using ohmmeter to check control taper



STA-LOC technician kit

There's more to replacing a volume control, "pot", or trimmer than simply selecting the proper value in ohms and watts. Naturally you *need* the proper value, but you also need the correct *taper* or the circuit won't perform properly.

What's taper? Briefly, it's the way resistance changes as you rotate the shaft. There are three basic tapers normally used which match the needs of different kinds of circuits. The chart shows how each of the three works.

Audio taper (often called left hand logarithmic by people who like big words) gives you a small increase in resistance at the beginning of shaft rotation and a faster increase toward the end (clockwise rotation). This matches the response of the human ear and is the reason audio tapers are generally used in volume controls and similar shunt circuits.

Linear taper is just that. Resistance change is exactly proportional to shaft rotation. All standard wire-wound controls have linear tapers. Carbon controls with linear tapers are commonly used in tone controls, sweep controls and other straight voltage-division uses.

Reverse taper (right hand logarithmic) is the opposite of an audio taper. You'll get a big change in resistance in the first half of shaft rotation and very little in the last half. This taper is used with cathode voltage controls such as TV contrast and many bias voltage controls.

In the Mallory STA-LOC® control system, it's easy to remember which taper is which. Linear controls end with "L", and audio with "A", and reverse with "R".

You can check which taper is used in an unknown control by connecting an ohmmeter as shown in the drawing.

First, measure total resistance. Then turn the shaft to 50% of rotation. If resistance is 50% of total, you have a linear taper. If it is 10% to 20% of total you have an audio taper. If it is around 80% of total you have a reverse taper.

To be sure you have the exact control when you need it, ask your Mallory distributor to show you one of the STA-LOC technician kits. With a STA-LOC kit you can make exact on-the-spot replacements of any of literally *thousands* of single, dual, push-pull, tandem, or clutch controls. Pieces snap together and *stay* together. STA-LOC kits are sensibly priced and are real money-makers and time-savers. See your Mallory distributor for everything you need in controls, capacitors, batteries, switches, resistors, and semiconductors.

PICTUREPHONE CENTER
New York Telephone

WASHINGTON-NEW YORK-CHICAGO PICTUREPHONE SERVICE STARTS

Bell Telephone Co. inaugurated Picturephone service between New York, Washington and Chicago on June 24. Mrs. Lyndon B. Johnson was one of the first to use the service. She talked from Washington to Dr. Elizabeth Wood, a scientist with Bell Labs in New York.

Rates for the first 3 minutes are $16 between New York and Washington, $21 between Chicago and Washington and $27 between Chicago and New York. Also taking part were two deaf teen-agers, who read each other's lips.

INITIATIVE IS OK, BUT . . .

Colice Radio Laboratory, Inc., a Brooklyn electronics firm listing branch offices in Chicago, Kansas City, Los Angeles and San Francisco, turned out to be one youthful experimenter in a basement, according to a story released by the Better Business Bureau.

The "firm" had obtained samples and ordered equipment from several companies to complete work on projects such as "Satellite Tracking Station No. 9." Apparently no payments were forthcoming and the BBB received inquiries from several companies.

A request that the head of the company visit the BBB for an interview brought a nervous-looking man, who reported that he was the father of a 17-year-old boy with an abnormal interest in electronics. The boy had printed the Colice Labs letterhead and assembled, disassembled, and in general experimented in the family basement on the equipment received.

NO-MOVING-PARTS VALVE INVENTED BY WOMAN ENGINEER

Mrs. Barbara Lunde of NASA's Goddard Space Flight Center has invented a thermoelectric valve for controlling the jet spray of liquid propellants from satellite reaction jets. Such jets provide short bursts of power necessary to orient the satellite in space.

This thermoelectric valve freezes and thaws the liquid propellant right in the feed line from the fuel tank to the jet nozzle. Electric current applied in one direction to the device draws heat from the line and cools it until the propellant is frozen. Then, by reversing the current, heat is applied to the line, which melts the propellant and lets it flow free. The action takes place in milliseconds.

IN-FLIGHT CLOSED CIRCUIT TV?

Two similar plans being offered to major airlines, one by Sony and the other by Ampex, would enable airline passengers to choose, from their seats, movies, stereo music, landing and take-off pictures, and en-route scenery.

The Sony scheme has 5-inch receivers behind each armrest. The Ampex unit, called Travelvision, will provide screens from 6 to 9 inches. Both systems use video tape recorders.

U.S.-FINLAND MOONBOUNCE ON 144-MC BAND

As a result of bouncing radio signals off the surface of the moon, an important first in amateur radio communications was achieved on April 12, 1964 when Bill Conkel, W6DNG, Long Beach, Calif., had a two-way conversation with Lenna Souminen, OH1NL in Nakkila, Finland, on 144 mc. This frequency is normally considered usable for no more than a few hundred miles. Mr. Conkel experimented for more than a dozen years and discarded 58 antenna designs before accomplishing this feat.

IMP I'S ELECTRONIC EQUIPMENT SURVIVES 8-HOUR SUBFREEZE

Explorer XVIII, known as IMP (Interplanetary Monitoring Platform), has survived 8 hours in the earth's shadow and temperatures of more than 400° below zero, and resumed normal operation after shutting off automatically in the instrument-freezing cold. IMP remained in the earth's shadow so long because its highly eccentric orbit carries it out 122,000 miles into space at apogee.

CALENDAR OF EVENTS

ARRL National Convention, Aug. 21-23; New York Hilton Hotel, New York, N.Y.

1964 Western Electronic Show and Convention (WESCON), Aug. 25–28; Los Angeles Sports Arena and Hollywood Park, Los Angeles, Calif.

Hi-Fi Show, Sept. 10-13; San Francisco Hilton Hotel, San Francisco, Calif.

International Convention on Military Electronics (MIL-E-CON 8), Sept. 14–16; Shoreham Hotel, Washington, D. C.

1964 Conference on Radio Meteorology, Sept. 14–18; National Bureau of Standards Boulder Laboratories, Boulder, Colo.

First National Conference on Automotive Electrical & Electronics Engineering, Sept. 22–23; McGregor Community Conference Center, Wayne State University, Detroit, Mich.

Third Electronic Trade Exhibition, Sept. 23–29; Apollohal, Amsterdam, Holland.

New York High-Fidelity Music Show, Oct. 1–4; New York Trade Show Building, New York, N.Y.

20th Annual National Electronics Conference, Oct. 19–21; McCormick Place, Chicago, Ill.

AUTOTEXT
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read about it on page 77

RCA's
new
easy way
to learn
ELECTRONICS
at home

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- Course I leads to attainment of your First Class F.C.C. License and may be completed in the classroom or through home study.
- Course II gives you practical experience on a great variety of "live" electronic equipment in the Grantham Student Laboratory.
- Course III offers Advanced Electronics Training (including microwave and radar) and prepares you to advance to senior-technician status.

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Washington Division 821 — 19th Street, N.W., Washington, D.C. 20006	*Phone:* *ST 3-3614*

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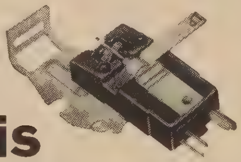
I AM INTERESTED IN: ☐ HOME STUDY ☐ RESIDENT CLASSES

This one is twice as safe.

When Sonotone designs a retractable cartridge, you can be sure it offers something extra. Like other retractable cartridges, the new Sonotone "21TR" withdraws into the safety of the arm to avoid bumps and bruises. Further, it has "bottoming" buttons which act as shock absorbers between the needle assembly and the record. Unlike other retractables, the "21TR" features the exclusive Sono-Flex® stylus, which can be dropped or mauled and still continue to provide superior performance. The high-output "21TR" is a direct replacement for the thousands of record players requiring a quality retractable cartridge.



This one is twice as safe and twice as compliant.

The new Sonotone "23T" offers performance specifications never before available in a budget-priced ceramic cartridge—plus record protection. High compliance of 10; channel separation of 24 db; output voltage of 0.38; low tracking force of 2 to 4 grams make it the ideal replacement in quality stereo phonographs. Performance is only half the story of the "23T". This new cartridge features "bottoming" buttons and the flexible Sono-Flex® needle. Another Sonotone cartridge, the "22T," offers the high performance of the "23T" with a slightly higher output. Both feature the Sono-Flex plus a unique snap-in mounting bracket, for rapid replacement without tools.

Both are direct replacements for popular makes

...and themselves.

SONOTONE audio products

Sonotone Corp., Electronic Applications Div., Elmsford, New York
Cartridges • Speakers • Microphones • Headphones • Hearing Aids • Batteries

ASEE AWARD TO FREDERICK TERMAN

Acting President Frederick E. Terman of Stanford University received the Lamme Award of the American Society of Engineering Education at the Society's annual meeting. Previous recipients include Dr. Vannevar Bush, Dr. Terman's old teacher at MIT; Karl Compton and Theodore von Karman.

Dr. Terman is a member of the National Academy of Sciences, a consultant to President Johnson's Science Advisory Committee and a member of the Committee of Twenty-Five chosen to develop a plan for a National Academy of Engineering.

LASER BEAMS MEASURE DEPTH OF MOON'S CRATERS

As reported by J. S. Courtney-Pratt of Bell Labs to the Society of Photographic Scientists & Engineers, the Armed Forces shot beams of laser light to the lip of a moon crater and then to the bottom. By timing the difference, engineers estimated that it is as much as 20,000 feet between the crater lip and the bottom. Comparable results have been obtained by measuring shadows in the craters.

Suggested uses for laser beams such as knocking branches off trees, cutting steel beams, death rays, or photographing large earth areas from the sky were dismissed as extravagant in Mr. Courtney-Pratt's report.

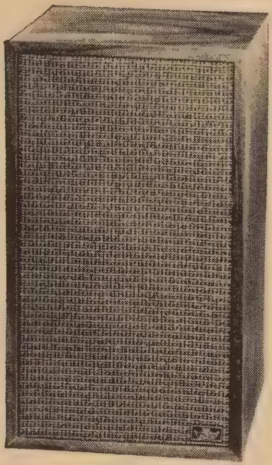
ELECTRONICS STOPS SHOPLIFTERS

Television cameras, two-way radios, walkie-talkies are being adopted by an increasing number of stores, and are effective both as a deterrent and a weapon of apprehension. This was pointed out at a meeting of the San Fernando Valley shoplifting committee, an organization of local merchants and store security officers.

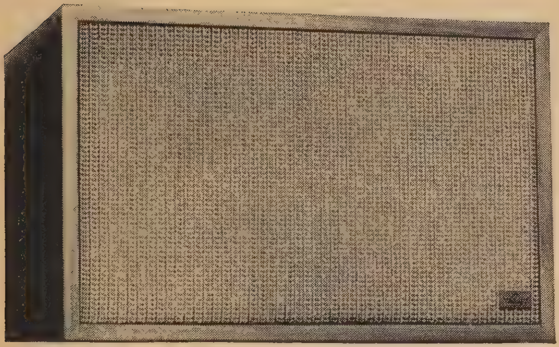
Even dummy cameras prove effective, it was reported.

New, revolutionary way to choose a speaker system:

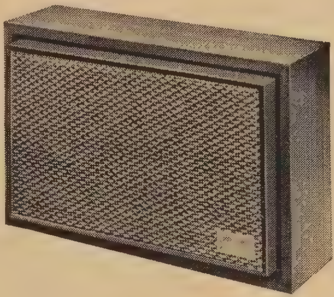
listen



UNIVERSITY
COMPANION II
Ultra-Linear
10" woofer,
3" mid-range,
3½" tweeter.
24x13½x11½"
D. $79.50



UNIVERSITY SENIOR II
Ultra-Linear 12" woofer, 3½" mid-range, Sphericon
Super-Tweeter; 25x15⅝x12⅛" D. $99.50



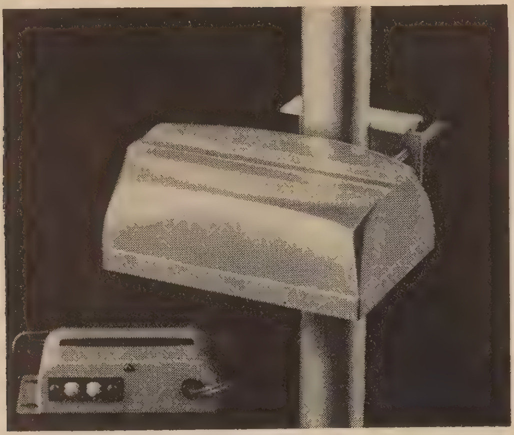
UNIVERSITY MINI-FLEX
6½" woofer, 3" mid-range
3½" tweeter. 15x9 7/16
x5 3/16" D. $69.95

UNIVERSITY COMPANIONETTE
Ultra-Linear 8" woofer,
3" mid-range, 3½" tweeter.
21¾x11½x8⅝" D. $69.95

...and listen and listen. New? Revolutionary? Yes—when you consider how many people buy speakers based on the recommendation of others. Sound involves **subjective** criteria. The sound that pleases a friend, (a hi-fi editor or salesman, for that matter) will not necessarily please you. Therefore . . . hear and compare many systems. For the largest selection, **start with University.** Choose the superb University model that best meets your requirements, then compare it to all other brands of its type. For example—if it's a full-size bookshelf you want, ask your dealer to demonstrate the Senior II vs. the AR, KLH, and other bookshelf systems of similar size. You'll hear the difference. Especially in the mid-range. Especially in the Senior's complete absence of restraint, that tell-tale drawback of so many other bookshelf systems. Unlike other systems, the sound of the Senior, the Companion, or of **every** University system, large or small—is **free** and **open**. The bass is cleanly defined; the mid-range punches through for greater presence; the highs literally have wings. Want proof? (Of course you do) Visit your dealer . . . and **listen.** University sounds better. Free 1964 Guide to Component Stereo! Write: Dept. RE-9.

LTV
UNIVERSITY
A DIVISION OF LING-TEMCO-VOUGHT, INC.
9500 West Reno, Oklahoma City, Oklahoma

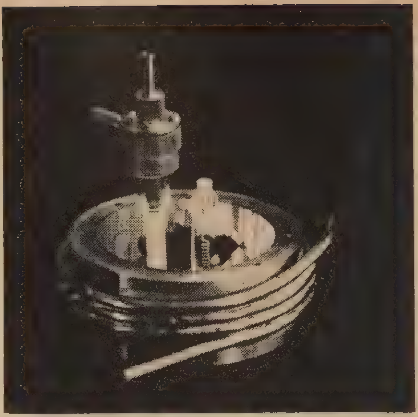
"Costs a bit more than 1 transistor VHF amplifiers."



"It should—it has two transistors."

"Fine, but is it worth the difference?"
"You bet, when you measure the couple extra dollars against the many hours of superb TV reception you will enjoy."
"Tell me more."
"The new Blonder-Tongue Vamp-2 outperforms all home VHF amplifiers on the market, tube or transistor. Brings in sharp, clear pictures."
"But, what's the real advantage of two transistors?"
"More signal power, lower noise for snow-free reception."
"But, I hear transistor units can overload from strong local TV stations?"
"Not this one, that's where the extra transistor pays off."
"I've got two sets."
"The Vamp-2 delivers strong signals to two sets. It has a built-in splitter. Great for color TV. List $38.95."
"Supposing I don't want to lay out the few extra dollars for the Vamp-2?"
"Simple solution. The new Blonder-Tongue Vamp-1... the best one-transistor model on the market. Lists at $25.50."

(This message was paid for out of the gross profits of
BLONDER-TONGUE, 9 Alling St., Newark 2, N.J.)



At left, projecting down into the housing, a 1-inch aluminum garnet crystal. To its right, the spiral-filament tungsten lamp that "pumps" the laser.

NEW SOLID-STATE LASER WORKS AT ROOM TEMPERATURE

A new rare earth aluminum garnet crystal optical maser (laser) is operating continuously at Bell Telephone Laboratories at room temperature—on light supplied by a tungsten lamp! Bell scientists, Dr. J. E. Geusic, H. M. Marcos and Dr. L. G. Van Uitert, produced the new crystal as a result of work on neodymium-doped yttrium aluminum, yttrium gallium and gadolinium gallium garnets.

Neodymium-doped yttrium aluminum garnet crystals operated in ordinary room temperature with light from a tungsten lamp with an input of 360 watts. Radiation was at 1.06 microns.

NO MINIATURIZATION FOR SOLID-STATE TV

Because the glass picture tube governs the cabinet size of a TV set, there is no great chance of sets becoming smaller as they are transistorized.

However, according to Texas Instruments, Inc., who are selling transistor kits to TV set manufacturers, the

4W7960
CITIZENS BAND AIDS

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FREE! **this deluxe new Four-Drawer FILE CABINET (with full-drawer suspension) worth $55.00—available only with your purchase of a PHOTOFACT LIBRARY consisting of 200 SETS** ***plus valuable Free extras!***

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- **Save 30¢ per Set—special $1.95 price applies on Easy-Buy (instead of regular $2.25 price)**

PLUS: In addition to the deluxe File Cabinet, you get a complete Color TV Servicing Course, 2nd Class Radiotelephone License Course, Transistor Radio Servicing Course, and Test Equipment Guide!

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MORE CONVENIENT AND
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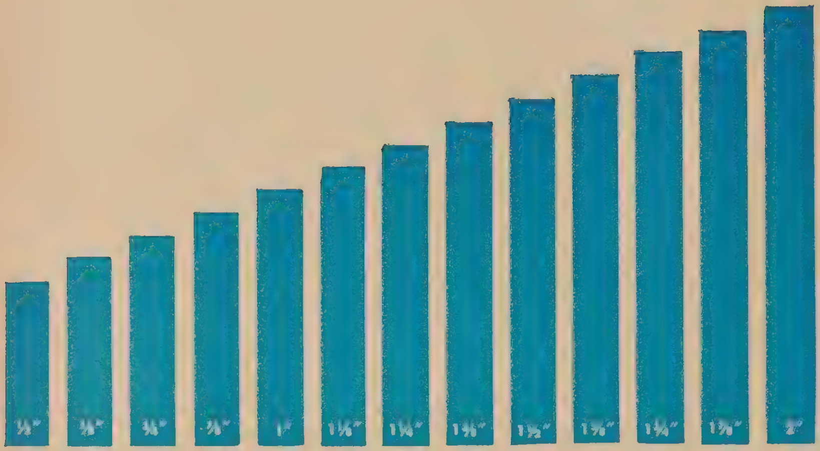
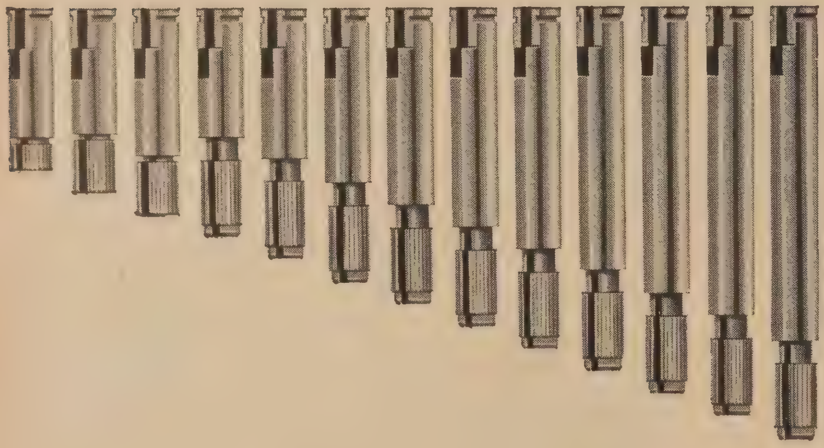
now
Centralab
gives you



SINGLE SHAFT CONTROLS

with exact length shafts



Need a control with a flat shaft—or split knurled—or screwdriver slot?

Maybe you need it with—or without—an attached line switch.

But two things are sure: You need a certain *exact* shaft length—and your Centralab distributor can supply it!

Centralab's new exact length solid shafts provide exact replacements for ALL your single control requirements, as well as twins for stereo, triples, and quads.

If you have the FRK-100 Fastatch II Kit, you can add these exact length shafts as you need them; they snap right into place on the Fastatch II front controls. Or, you can always get the exact control you need, instantly, from your Fastatch II distributor.

For a complete catalog on the Fastatch II Control System, write to Centralab or contact your distributor.

Centralab

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B-6420

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Use Quam Hi-Fi Speakers in new systems, as extension speakers in existing hi-fi systems, and as replacement improvements in stereo consoles. They'll open your way to exciting new sales!

Write for your free copy of the new Quam Hi-Fi Catalog HF-64.

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selling gimmick will be a 5-year warranty on the transistors.

The semiconductor manufacturer predicts that up to 100,000 transistorized TV sets will be sold this year.

RADAR SOUNDINGS FROM JUPITER

Last fall, independent groups of American and Soviet scientists experimented nightly for a month aiming signals at Jupiter. In a report in the magazine *Science*, Dr. Richard M. Goldstein of Caltech said that the return signals received offered strong evidence that they were indeed returning from Jupiter, and indicated a high degree of smoothness for part of the planet's reflecting surface, a smoothness greater than that of Mars and far greater than Venus'. This smooth area is not in the planet's famous red spot.

UHF TUNERS TO "CLICK" THIS WINTER?

The second detent uhf tuner of the season has been announced by the F. W. Sickles Div. of General Instrument. An earlier one had already been announced by Oak Manufacturing Co. Motorola is using a pushbutton system on its better black-and-white sets.

BRIEF BRIEFS

Pilot Radio Corp., which dropped TV in 1952 (after making the first of the "tinyvisions") to make hi-fi equipment, is returning with a line of home-entertainment centers featuring color television, and a new line of sidetable stereo instruments, both equipped with solid-state electronics.

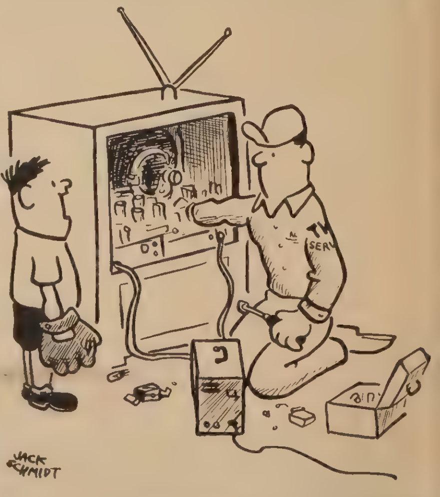
Raytheon reports peak-power outputs of 100 megawatts from a pulsed ruby laser, the highest peak power yet reported for a high-repetition laser. Pulse widths were 10 nanoseconds at repetitions greater than 1 pulse per second.

Small integrated transistor power supply regulator, made by Trio Labs of Plainview, N. Y., is packed in a power transistor case and sold as a superregulated Zener diode. The unit is intended to be inserted in a power supply like any other Zener diode, but with, however, vastly improved performance.

A New York hotel, the Rutledge, on Lexington Ave., is attempting to establish itself as "ham headquarters." Special discount rates are offered guests who produce an operator's license when registering, and an amateur station is available for the use of visiting hams.

NASA is testing an electronic shark repeller, a device that radiates a wide spectrum of frequencies from a 36-inch underwater dipole antenna. The frequency that repels the shark has not been identified, but it is believed that it affects the shark's sense of "smell".

RCA reports that color sets accounted for 3 out of every 10 set sales during the first part of 1964 END



"Are you the man that daddy says he's not going to pay?"

make it easy on yourself
See the direct answer—on only the range-scale you want—automatically

B&K
Model 360
V O Matic

Automatic Volt-Ohm-Milliammeter

WITH BURN-OUT PROOF METER MOVEMENT

Sensitivity 20,000 ohms per volt DC; 5000 ohms per volt AC. **Accuracy** ±3% DC; ±5% AC; (full scale). **DC Volts** in 6 ranges 0-6000. **AC Volts** in 6 ranges 0-6000. **AF** (Output) in 4 ranges 0-300 volts. **DC Current** in 5 ranges 0-10 amps. **Resistance** in 4 ranges 0-100 megohms. Supplemental ranges also provided on external overlay meter scales. Meter movement protected against extreme overload and burn-out. Polarity reversing switch. Automatic ohms-adjust control. Fuse-protected shunts. Mirrored scale. Complete with 1½-volt and 9-volt batteries, test leads, and easy-viewing stand. Batteries freshly packed separately.

No Reading Errors!
No Multiplying!

Just set the range switch, and only the scale you want in the exact range you want appears *automatically*. Individual *full-size* wide-view scale for each range—and only one range-scale is visible at any one time. *Reading is clear, easy—and direct.* Net, $\$59^{95}$

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It's automatic! See only the full scale you want and read the exact answer—directly. No multiplying. Eliminates errors. Net, $\$89^{95}$

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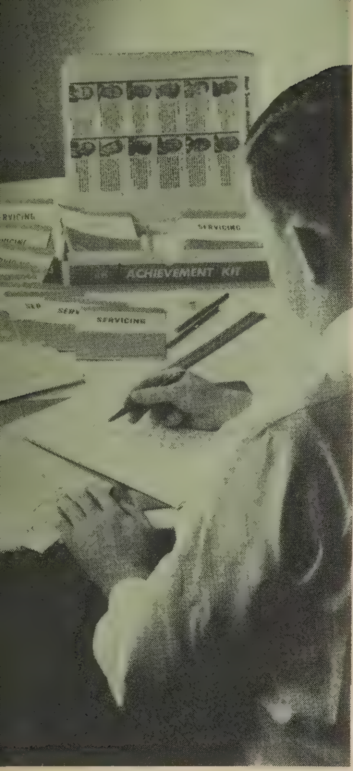
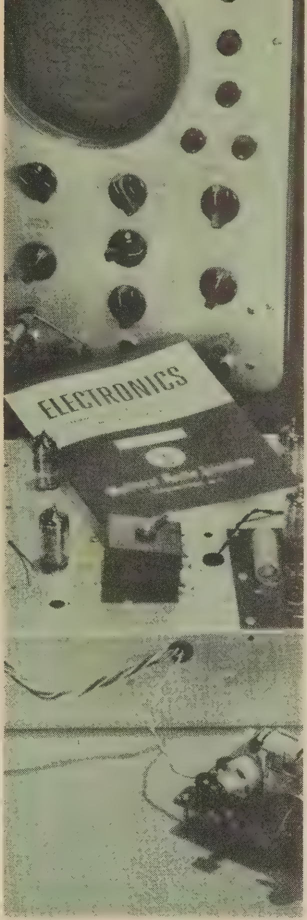
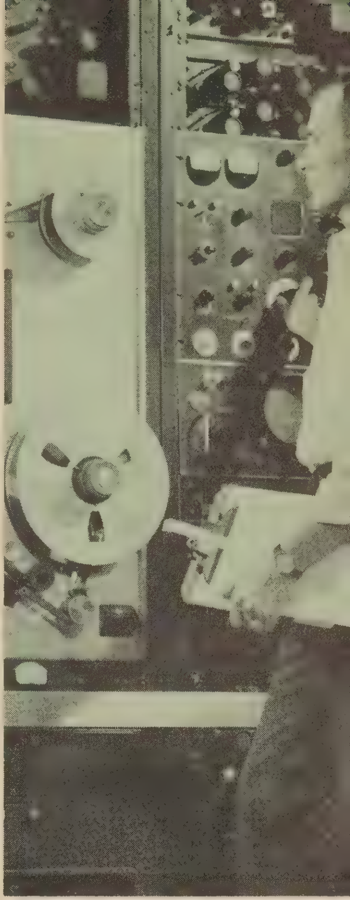
Export: Empire Exporters, 253 Broadway, New York 7, U.S.A.







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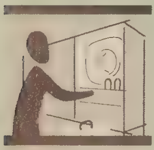

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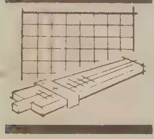

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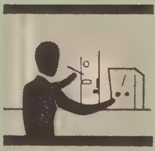

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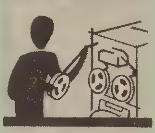

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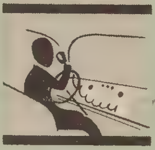

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"I am a Senior Engineering Aide at Litton Systems, in charge of checkout of magnetic recording devices for our computers. Without the help of NRI I would probably still be working in a factory at a lower standard of living." **DAVID F. CONRAD,** Reseda, Calif.

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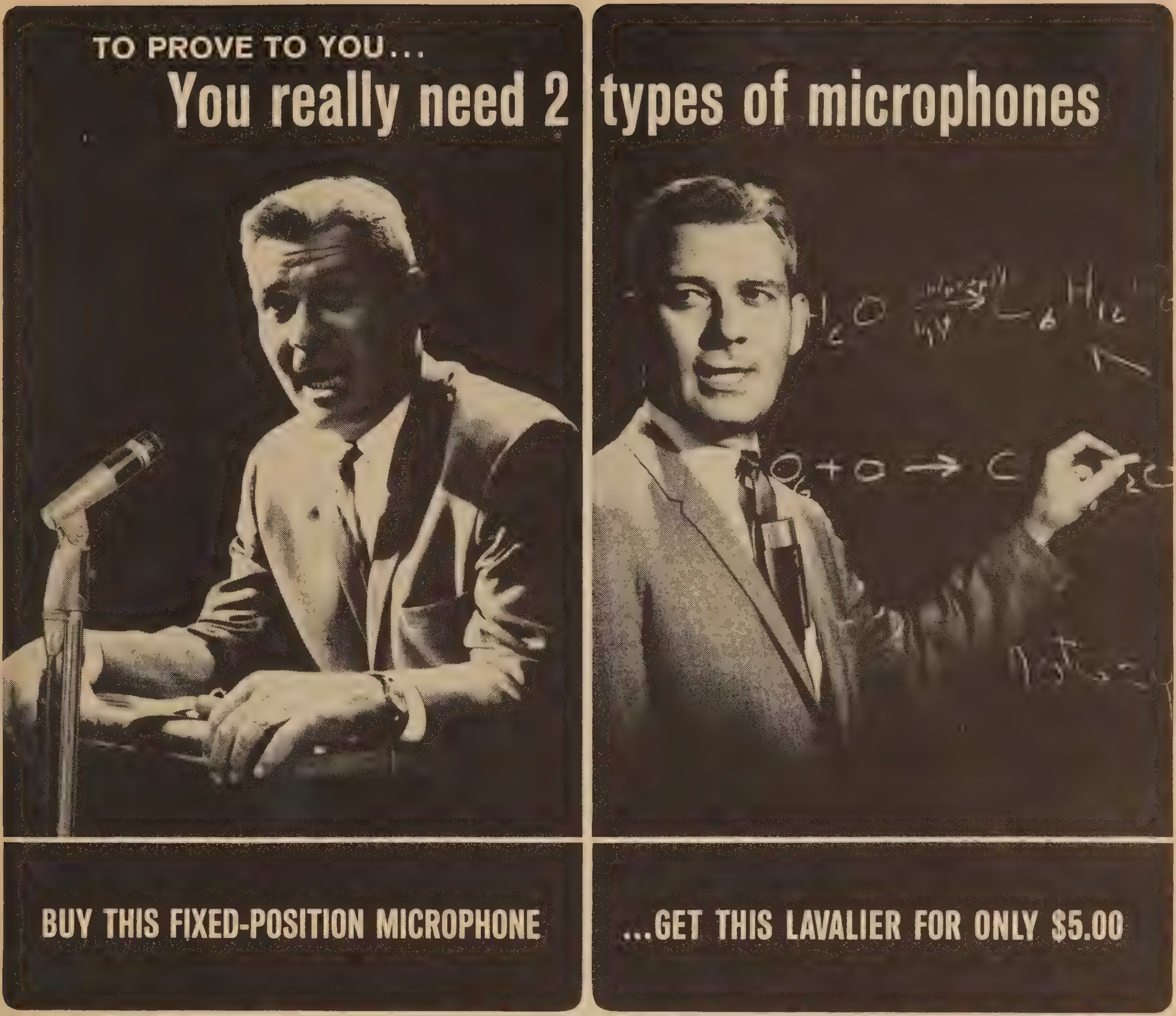
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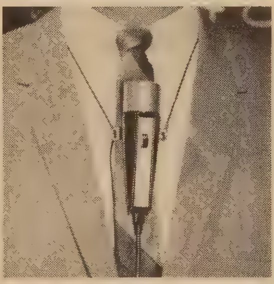

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Correspondence

OLD BACK ISSUES— REAL COLLECTORS' ITEMS

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THOMAS H. CURTIS
99 Harrison Ave.
Fair Haven, N. J. 07702

THE ERRONEOUS SPLITTER

Dear Editor:

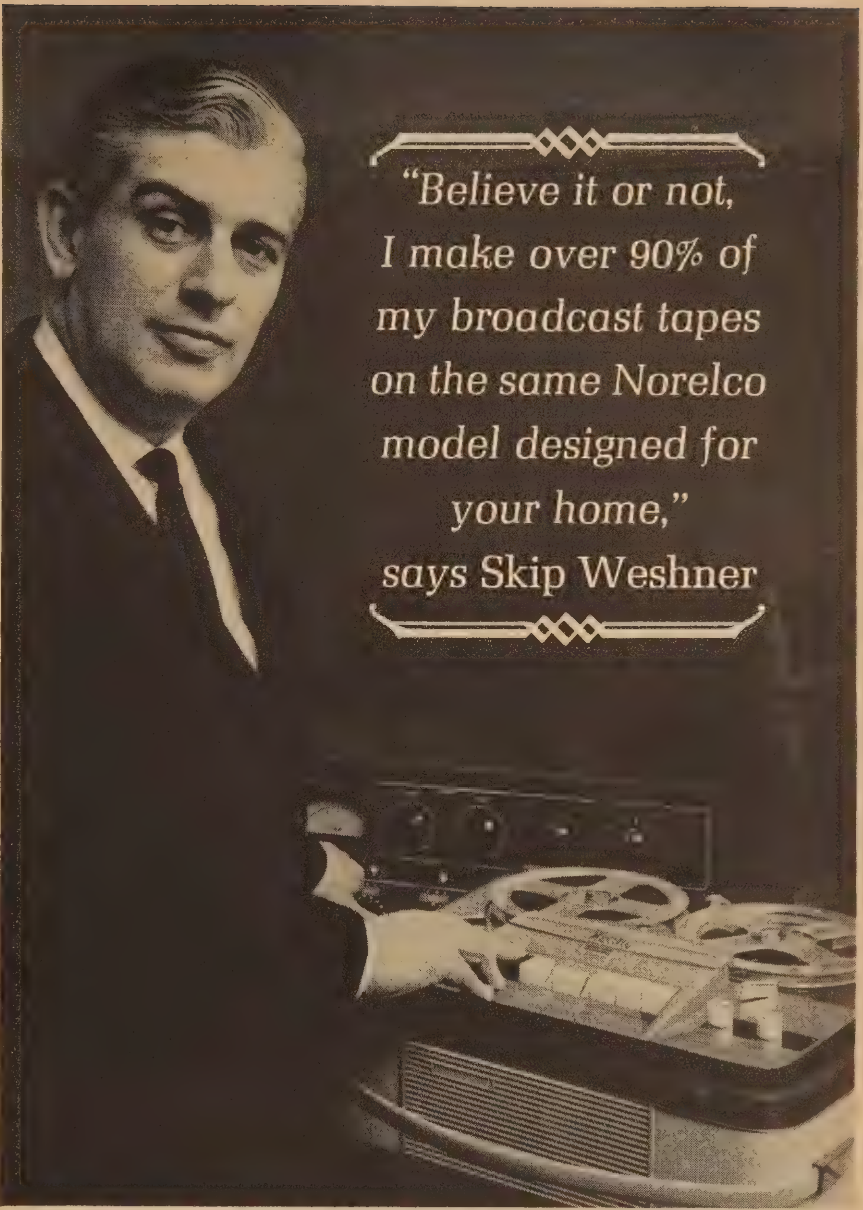
Described in Try This One (June 1964, p. 84) was a device for matching multiple antennas to a single set or, equally well, one antenna to a number of sets. Unfortunately, the equation for determining R, the value of the shunt resistor to be used, is wrong. The equation for an N-port device with equal impedances at all ports is

$$R = \frac{NZ}{N-2}$$

The error in the original equation (where $N-1$ appeared in the denominator) is readily apparent by taking $N = 2$, a two-port pad—i.e., matching one set to one antenna. The value of R obtained, $\frac{2Z}{2-1} = 2Z$, would mean the impedance looking into the open port would be 2Z, 2Z and Z all in parallel, or Z/2. This is obviously a mismatch for a source of Z.

A little more thought along this line indicates that *any* finite resistance would mismatch the two-port system, since the second port impedance Z alone provides the correct match. In mathematical terms, $R = \infty$. The correct equation, ($R = \frac{NZ}{N-2}$) shows this for two ports, since $\frac{2Z}{2-2} = \infty$.

In the laboratory, the most common application for the splitter is for


"Believe it or not, I make over 90% of my broadcast tapes on the same Norelco model designed for your home," says Skip Weshner

"My tapes have to meet the broadcast standards of the leading FM stations around the country, whose other taped programs are normally recorded and played back on professional broadcast-studio consoles. My Norelco '401' gives me tapes that not only meet or exceed these standards, but on playback on the '401' I defy any listener to tell the difference between my live broadcasts and my taped ones!

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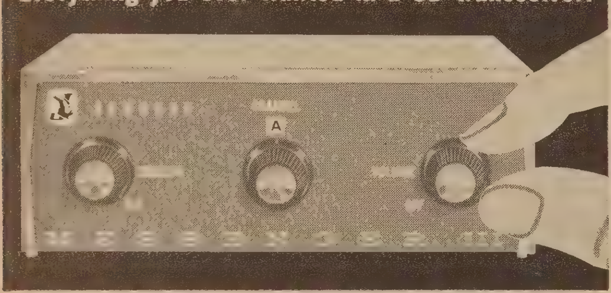

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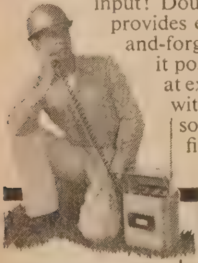

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REPORT ON AMPLIFIED ANTENNAS

Are those antennas-with-transistors any good? If so, how much? Can they actually make reception worse? Is there a difference in performance between the ones that look like a box and those that resemble rabbit ears more closely? *Radio-Electronics* tested a number of these "amplified antennas." Next month, read what we found out!

MOCKUP BENCH JIG SPEEDS COLOR SERVICE

Homer Davidson tells how an old color trade-in TV can be made into a time-and-money-saver for the TV shop starting to service color. Saves one man on color TV calls. Learn how he does it.

MODERN STEREO CARTRIDGE REVIEW

A complete roundup of all the leading stereo cartridges—some of the differences between them, what they will do, and how they affect the listening audiophile. Not a colorless table of measurements—these cartridges were tested by playing records, and our reviewer reports on how they sound.

You'll find these and many other articles, features and regular departments in next month's RADIO-ELECTRONICS.

OCT. ISSUE (on sale Sept. 17)

what PARALOG brought to VHF...
NEW
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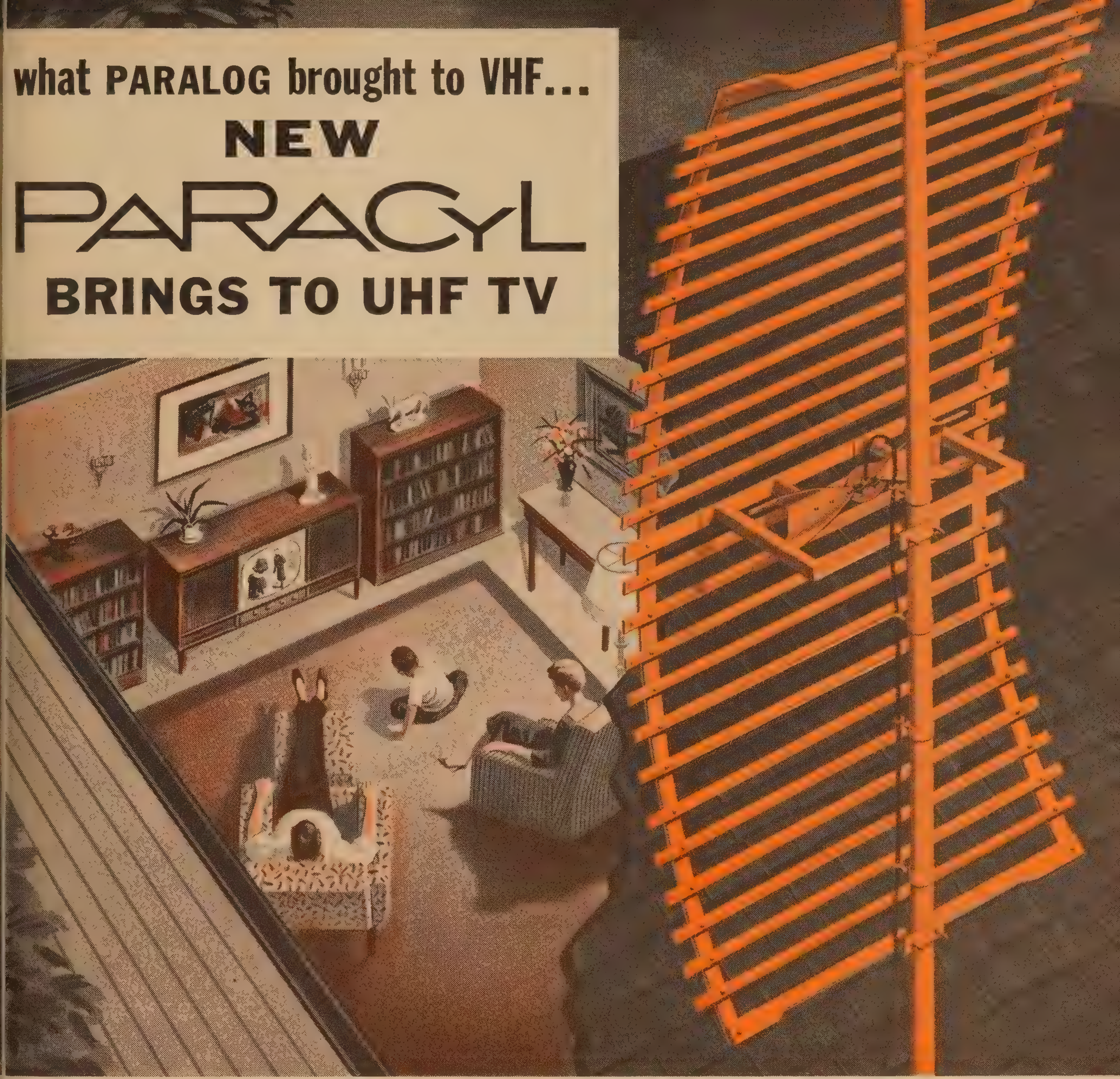

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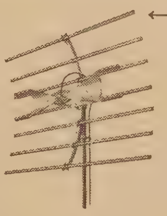
*Patent pending



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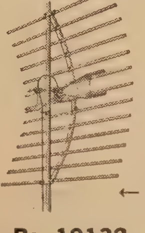

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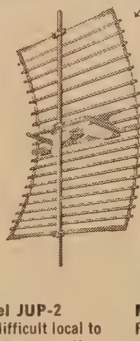

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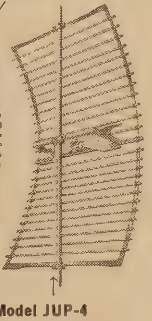

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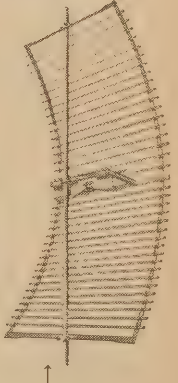

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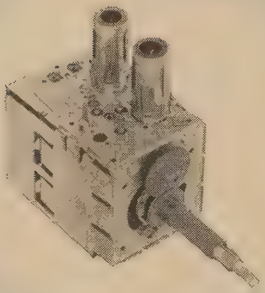

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connecting multiple signal generators to one receiver (or active circuit), and I have often used the devices for that. However, I must object to the editor's use of the term *balanced.* A balanced circuit or network is defined as one in which the two sides are electrically alike or symmetrical to a common reference point, usually ground. The device shown is obviously not balanced when one considers any antenna as a source generator and the set as the receiver load; it is simply *ungrounded.*

LAWRENCE C. MIDDLEKAMP
Laurel, Md.

REDS SHOULD BE READ

Dear Editor:

"Double Bridge Sensitivity" in the June 1964 issue is reminiscent of a circuit described in a book on meteorological tower instrumentation published last year in Russia. Does this mean that electronic hobbyists are missing some good bets if they fail to keep up with the Russian literature?

By the way, the miniature tape recorder mentioned by Steve P. Dow on p. 89 of the May issue can be used with a Knight-Kit 83Y261D tuner and a suitable speaker to make an inexpensive AM receiver for periods when the recorder would otherwise be loafing. The tuner output is plugged into the microphone jack, and the speaker into the earphone jack. With the recorder in the forward record mode, there is plenty of signal for the speaker. I use a retired 12-inch Jensen, but I have to admit it sounds better with 200 μf across its terminals. Perhaps another reader could suggest some refinements for this hookup.

STU KELLOGG
Lexington, Mass.

STICK IN A SURGE RESISTOR TO BE SURE

Dear Editor:

In the August 1963 issue of RADIO-ELECTRONICS you had an article by Earl Hansen titled "Chopper Stabilized dc Amplifier." While most of the schematic is correct, Mr. Hansen omitted one very important component: the surge resistor preceding diode D5 in the power supply. Although a 1N2070 can handle up to a 6-amp peak for a small fraction of a second, a charging 80-μf capacitor will quickly destroy the diode. A 68-ohm ½-watt carbon resistor between the transformer and the diode limits the initial charging current and protects the diode.

GERALD FELDMAN
Los Angeles, Calif.

[Mr. Feldman's suggestion is a good one—putting in a surge-limiting resistor can hardly do any harm. But often, in low-current power supplies like the one in Mr. Hansen's amplifier, the dc resistance of the power transformer secondary is 100 ohms or more per half, limiting the maximum inrush current to an ampere or two.—*Editor*]

TWO MORE USES FOR THE 6BN6

Dear Editor:

In the June 1964 issue of RADIO-ELECTRONICS, Leo Sands left out two valuable applications of the 6BN6:

1. As a gated-beam mixer good to at least 30 mc—described in Markus and Zeluff, *Electronics for Communications Engineers,* McGraw-Hill, 1952, p. 38.

2. As an excellent product detector for single-sideband reception—described in *Single Sideband for Amateur Radio,* American Radio Relay League (ARRL), 1962, p. 79.

I believe that this tube can also be used as a balanced modulator for generating SSB and DSB, but I cannot recall where I saw the circuit.

K. J. DESKUR
Endicott, N.Y.

NATESA VS. FTC: PROBLEM STILL THERE

Dear Editor:

As a subscriber to RADIO-ELECTRONICS and several other publications, clubs and societies in electronics, I would appreciate a chance to comment on the Federal Trade Commission's decision barring NATESA from "blackballing" those distributors and wholesalers who trade with the general public and with part-time technicians.

Although I cannot agree with NATESA's view on the part-time technician, since I have known some who could challenge the best of the full-time professionals, I assume that the FTC and NATESA agree on how best to cure their patient.

But, a question: How is the FTC empowered to deal with those distributors and wholesalers that trade with the public on the same terms—and often better terms—than with dealers and service outfits? It is well known that, in Manhattan especially, this kind of trading hurts even the public, not to mention the scores of small businesses now and in the future.

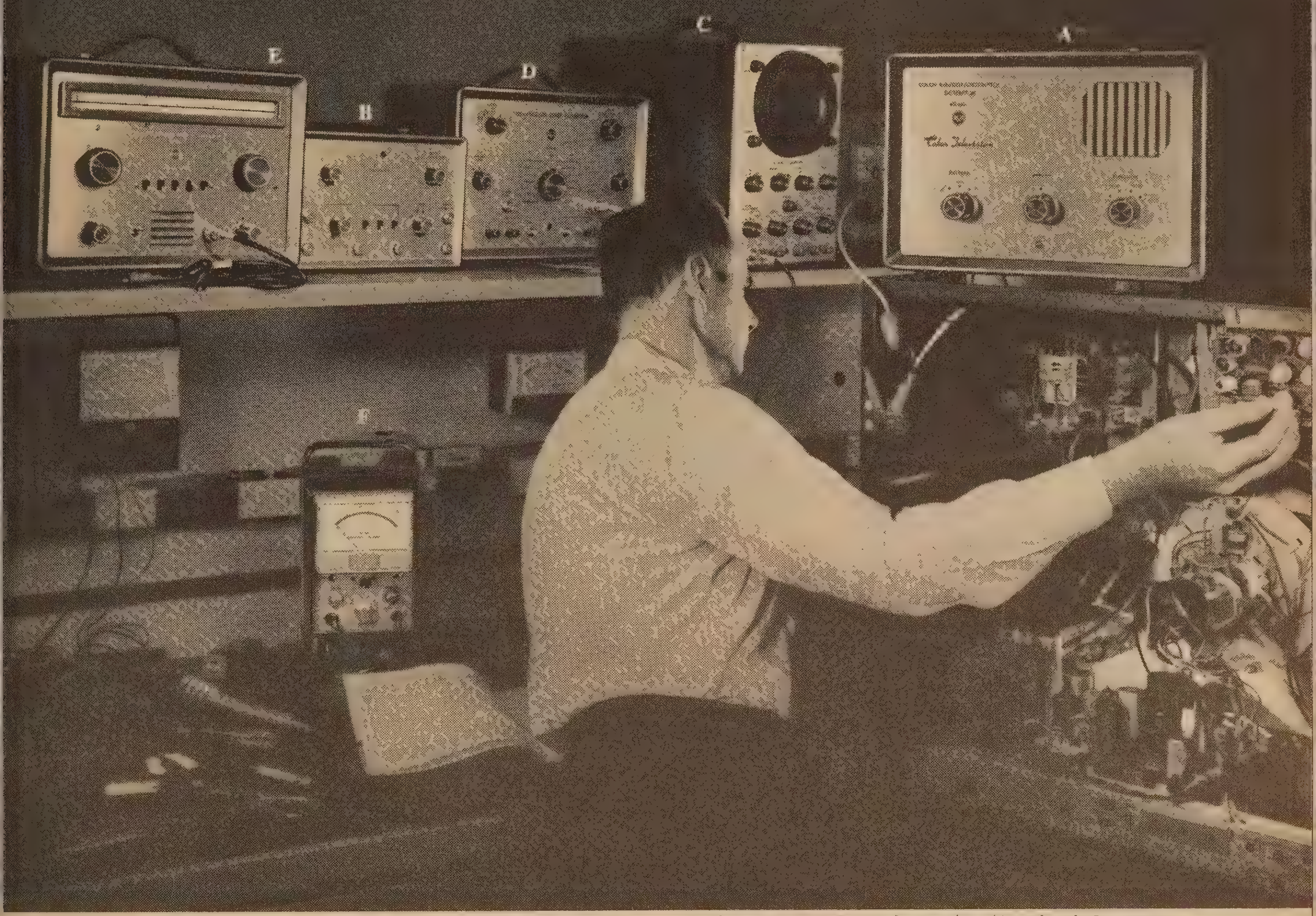
Does the FTC have any answer to that problem?

J. S. BUITRAGO
Riverdale, N. Y.

END

Color-TV servicing is profitable

GET THE MOST OUT OF IT WITH COLOR-TV TEST INSTRUMENTS FROM RCA—PIONEER OF COLOR TV



Making last-minute convergence adjustments on a color-TV receiver with an RCA WR-64A Color-Bar/Dot/Crosshatch Generator.

(A) RCA WR-64A COLOR-BAR/DOT/CROSSHATCH GENERATOR

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns:
- *Color-bar pattern:* ten bars of color for checking phase and matrixing, and for automatic frequency and phase alignment.
- *Crosshatch pattern:* thin sharp lines for adjusting vertical and horizontal linearity, static and dynamic convergence, raster size, and overscan.
- *Dot pattern:* small dots to facilitate accurate color convergence.

$189.50* with output cables

(B) RCA WR-70A RF/VF/IF MARKER ADDER

For use with a marker generator and a sweep generator. Used for RF, IF, and VF sweep alignment in color and B&W TV receivers.
- Choice of four different marker shapes
- Provides very high-Q markers of high amplitude and narrow bandwidth

$74.50* complete with cables

(C) RCA WO-91A 5-INCH OSCILLOSCOPE

A wideband scope for checking colorburst signals and general troubleshooting.
- Dual bandwidth: 4.5 Mc at 0.053 volt rms/in. sensitivity; 1.5 Mc at 0.018 volt rms/in. sensitivity.
- Continuously adjustable sweep frequency range: 10 cps to 100 Kc

$249.50* including direct/low capacitance probe and cable, ground cable, and insulated clip.

(D) RCA WR-69A TELEVISION FM SWEEP GENERATOR

For visual alignment and troubleshooting of color and B&W TV receivers, and FM receivers.
- IF/Video output frequency continuously tunable from 50 Kc to 50 Mc.
- Sweep-frequency bandwidth continuously adjustable from 50 Kc to 20 Mc on IF/Video and FM; 12 Mc on TV channels

$295.00* including all necessary cables

(E) RCA WR-99A CRYSTAL-CALIBRATED MARKER GENERATOR

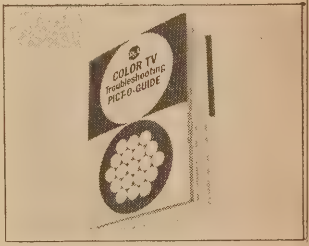
Supplies a fundamental frequency RF carrier of crystal accuracy for aligning and troubleshooting color and B&W TV receivers, FM receivers.
- Most-used IF and RF frequencies indicated on the dial scale
- Sound and picture carrier markers available simultaneously

$256.50* complete with output cable and phone tip

(F) RCA WT-115A COLOR PICTURE TUBE TESTER

Designed specifically to test color-TV picture tubes, either in or out of the set. Tests each gun for emission quality, inter-electrode leakage and shorts.
- Large sensitive meter with separate 3-color scales
- Provision for accurate adjustment of cut-off point for each gun

$89.50* with cable, carrying case and socket assembly



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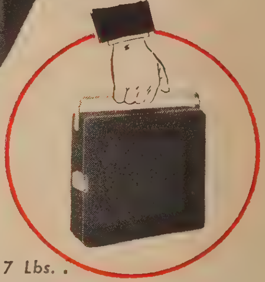

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Here's the famous MIGHTY MITE, America's fastest selling tube checker, with an all-new look and many new exclusive features. MIGHTY MITE III brings you even greater portability, versatility and operating simplicity beyond comparison. Controls are set as fast and simply as A-B-C right from the speedy set-up cards in the cover. The new functional cover can be quickly removed and placed in a spot with more light for faster reading of the set-up data or "cradled" in the specially designed handle as a space saver as shown above. New unique design also prevents cover from shutting on fingers or cutting of line cords as in older models.

In a nut shell . . . the MIGHTY MITE III is so very popular because it checks for control grid contamination and gas just like the earlier "eye tube" gas checkers (100 megohm sensitivity) and then with a flick of a switch, checks the tube for inter-element shorts and cathode emission at full operating levels. Sencore calls this *"the stethoscope approach"* . . . as each element is checked individually to be sure that the tube is operating like new. User after user has helped coin the phrase *"this checker won't lie to me"*. Most claim that it will outperform large mutual conductance testers costing hundreds of dollars more and is a real winner in finding those "tough dogs" in critical circuits such as color TV and FM stereo.

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As electronics moves ahead in the space age.
will you be left behind?
CREI

THE SPACE AGE AND AUTOMATION ARE CHANGING THE ELECTRONICS INDUSTRY. JOBS ARE FEWER, HIRING REQUIREMENTS TOUGHER. THERE IS VIRTUALLY NO DEMAND FOR MEN WITH ORDINARY QUALIFICATIONS. BUT MEN WITH SPECIALIZED KNOWLEDGE OF NEW AND EXPANDING AREAS OF ELECTRONICS ARE STILL IN SHORT SUPPLY.

Because you work in electronics, you know the cold, hard facts about employment opportunities in this field today. Many men are unemployed or will soon lose their jobs because the electronics they know is out-of-date and they have failed to learn enough about new developments to pull their weight on the job. Other men are unemployed because the routine jobs they held have been eliminated by the new automated manufacturing techniques of the space age.

Yet, at the same time that many men are being let go, leading companies are searching for men with specialized knowledge of new and expanding areas of electronics.

WILL THE SPACE AGE END YOUR CAREER IN ELECTRONICS? OR WILL IT OPEN UP NEW OPPORTUNITIES FOR YOU?

That depends on whether or not you supplement your education in electronics with the new knowledge required by employers today. If you don't, you can forget about your career in electronics. Guiding space vehicles demands knowledge that didn't exist when you went to school—and is almost impossible to acquire on the job. And, even if you work for a company that is not directly involved in space, it is probably already using techniques developed in the space program.

f you bring your education up to space age standards, you can look orward to a rewarding and exciting career as a sought-after specialist n one of the new and advanced areas of electronics.

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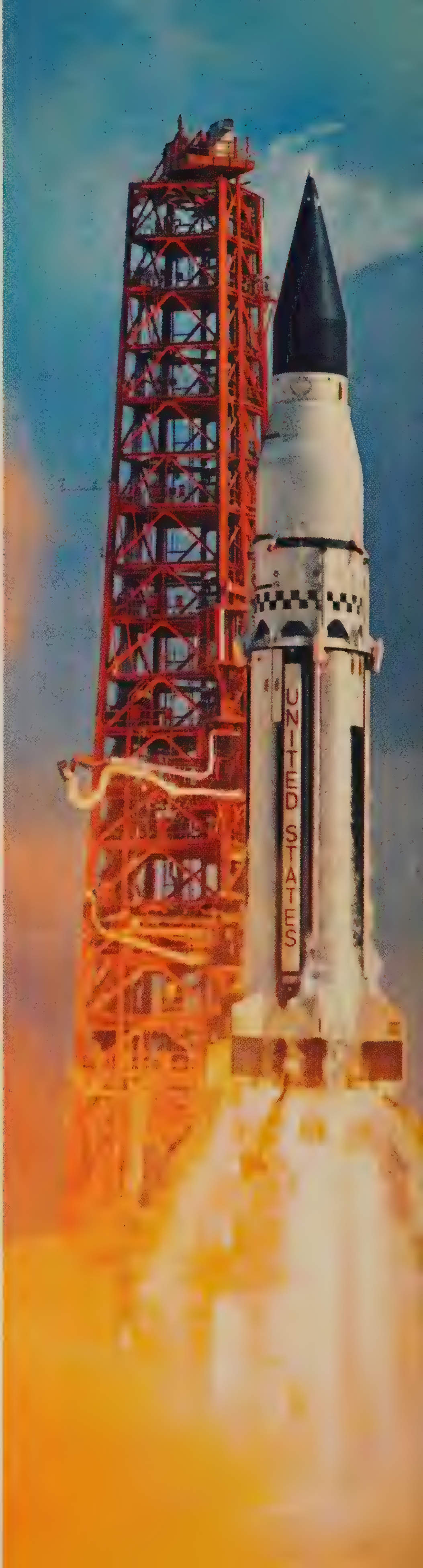
CREI's Programs in Space Electronics enable you to study at home, on your own schedule—through methods developed in more than 37 years of experience in education through home study.

Long and painstaking effort has been devoted to the preparation of hese programs. CREI faculty members visited 14 government and private technical organizations in the space effort to determine exactly what knowledge of electronics they want in men they employ. Engineers and scientists from some of these organizations have been retained as consultants to supply the technical material for hese programs.

Photographs courtesy of National Aeronautics & Space Administration



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The Picturephone In Your Future

Radio-Electronics
Hugo Gernsback, Editor-in-Chief

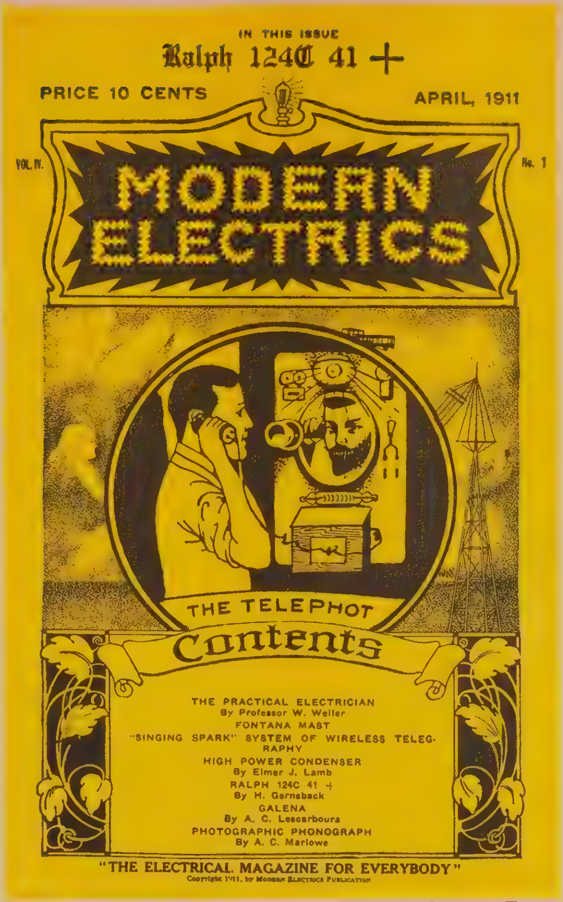
. . . Immense Are the Coming Applications of This Great Device . . .

ON APRIL 20, 1964, the American Telephone & Telegraph Co. unveiled its newest device, the *Picturephone,* at the New York World's Fair. (The Picturephone is shown on page 6 of the July 1964 RADIO-ELECTRONICS.) Viewers could see people across the country, as far away as Los Angeles, Calif., in a coast-to-coast press conference. Ever since, the long-awaited "See-as-you-talk" phone has been drawing huge crowds at the AT&T pavilion at the Fair. There, soundproof booths equipped with Picturephones allow visitors to talk with each other or with a nearby telephone operator. Visitors sit about 3 feet from the little instrument's screen, housed in a small desktop table set. Normal room illumination is sufficient for the little vidicon tube next to the set's screen to give a good picture. On June 24, the Picturephone went into commercial use in a circuit linking public booths in New York, Washington and Chicago.

Picture size is 4⅜ x 5¾ inches. The control set uses no dial; it has pushbuttons which allow you to see yourself, another person or nothing at all at your choice.

The idea of the long-distance Picturephone is hoary with age. It probably was first used anywhere in word and picture in my novel, *Ralph 124C 41+* (A Romance of the Year 2660), originally published in installments beginning with the April 1911 issue of *Modern Electrics,* forerunner of RADIO-ELECTRONICS.

For the record, 53 years ago the instrument was known as the *Telephot.* As the story opens, Ralph 124C 41+, one of the world's most renowned scientists and one of the ten celebrated *Plus* men of the Planet, is talking from New York long distance to a friend, over the telephot.



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Ralph 124C 41 +

PRICE 10 CENTS
APRIL, 1911

VOL. IV.
No. 1

MODERN ELECTRICS

THE TELEPHOT

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FONTANA MAST
"SINGING SPARK" SYSTEM OF WIRELESS TELEGRAPHY
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By Elmer J. Lamb
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By H. Gernsback
GALENA
By A. C. Lescarboura
PHOTOGRAPHIC PHONOGRAPH
By A. C. Marlowe

"THE ELECTRICAL MAGAZINE FOR EVERYBODY"
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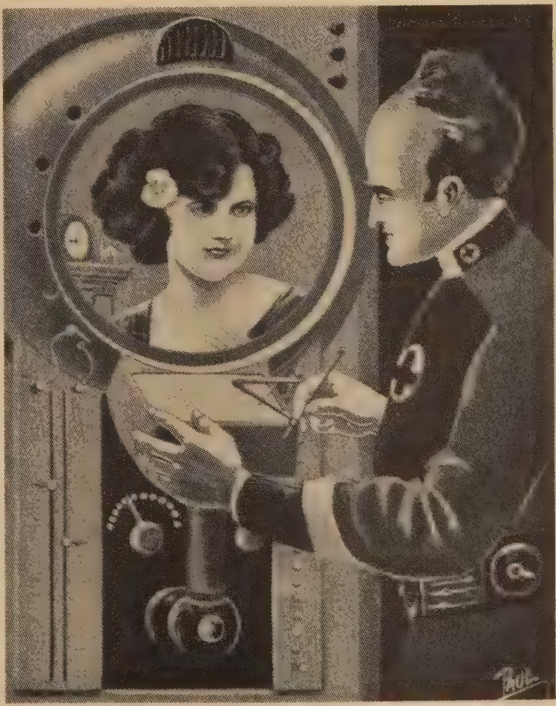
Front cover of the April 1911 issue of MODERN ELECTRICS, *illustrating the use of the earliest known Telephot, now called the Picturephone.*



This 1925 illustration of the Telephot, now known as the Picturephone, appeared in the first book reprint of the novel RALPH 124C 41+. Note microphone on top of loudspeaker, openings at left. The Telephot also foresaw the Language Rectifier, so far not realized.

Suddenly there is an interruption, just as we have today—and the screen of the telephot goes blank. Then:

"At this moment the voice ceased and Ralph's faceplate became clear. Somewhere in the Teleservice company's central office the connection had been broken. After several vain efforts to restore it Ralph was about to give up in disgust and leave the Telephot when the instrument began to glow again. But instead of the face of his friend there appeared that of a vivacious beautiful girl. She was in evening dress and behind her on a table stood a lighted lamp.

"Startled at the face of an utter stranger, an unconscious 'Oh!' escaped her lips, to which Ralph quickly replies:

" 'I beg your pardon, but 'Central' seems to have made another mistake. I shall certainly have to make a complaint about the service.'

"Her reply indicated that the mistake of 'Central' was a little out of the ordinary, for he had been swung onto the Intercontinental Service as he at once understood when she said, *'Pardon, Monsieur, je ne comprends pas!'*

"He immediately turned the small shining disc of the *Language Rectifier* on his instrument till the pointer rested on 'French.' "

This starts the great international and interplanetarian romance, with the heroine, Alice, in distant Switzerland. Ralph subsequently saves her, via electronics, from an immediately threatening avalanche.

While the Picturephone is now an assured fixture, what are its implications for the future?

At present, while it is new, it still is a luxury. AT&T made public its rates: $16 for the first three minutes between New York and Washington, $21 between Chi-

continued on page 81

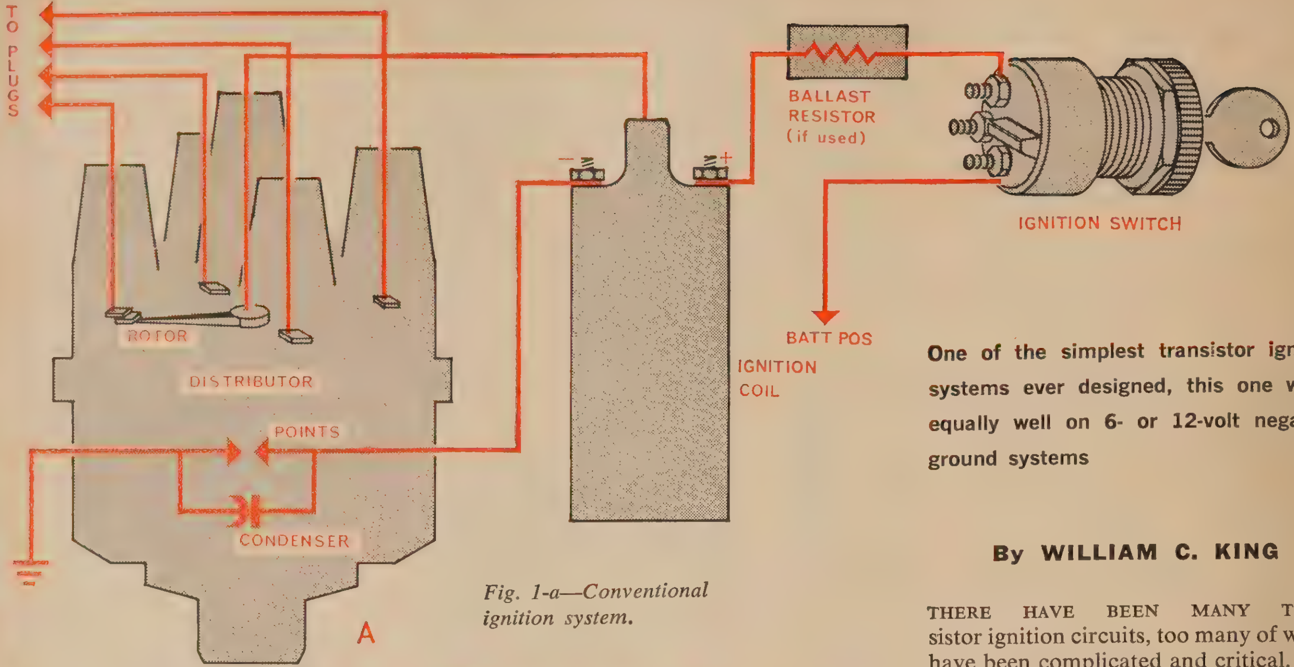

TO PLUGS
BALLAST RESISTOR (if used)
IGNITION SWITCH
−
+
BATT POS
IGNITION COIL
ROTOR
DISTRIBUTOR
POINTS
CONDENSER
A

Fig. 1-a—Conventional ignition system.

Zenerless Transistor Ignition

One of the simplest transistor ignition systems ever designed, this one works equally well on 6- or 12-volt negative-ground systems

By WILLIAM C. KING

THERE HAVE BEEN MANY TRANsistor ignition circuits, too many of which have been complicated and critical. This circuit uses a basic series-connected transistor switch for simplicity. To eliminate the need for a special coil to lower the back voltage so that one or two transistors can take it, I've used three in series. The price of one or two more transistors is usually less than that of a special coil. The fact that no Zeners are used makes the system even more attractive.

Three 2N174's in series (see schematic) will withstand 240 volts, more than enough for a standard coil. They need not be matched, but the three in series require a network of base resistors to balance the voltage. R5, R6, R7 balance the "off" (high) voltage equally across the transistors. R1, R2 and R3 balance the transistors for an even voltage drop during conduction. The diodes provide base isolation, and R4 limits the total base current to around 0.75 amp. Theoretically the values for R5, R6 and R7 or for R1, R2 and R3 should be the same, but transistor characteristics vary. If you start with the values I have given, you should come close.

Construction and installation

I mounted the transistors on a ⅛ x 3 x 6-inch heat sink with the other parts on terminals between them.

After the system is built, you will need a 6-amp 12-volt power supply and a 2-ohm 100-watt resistor to adjust it.

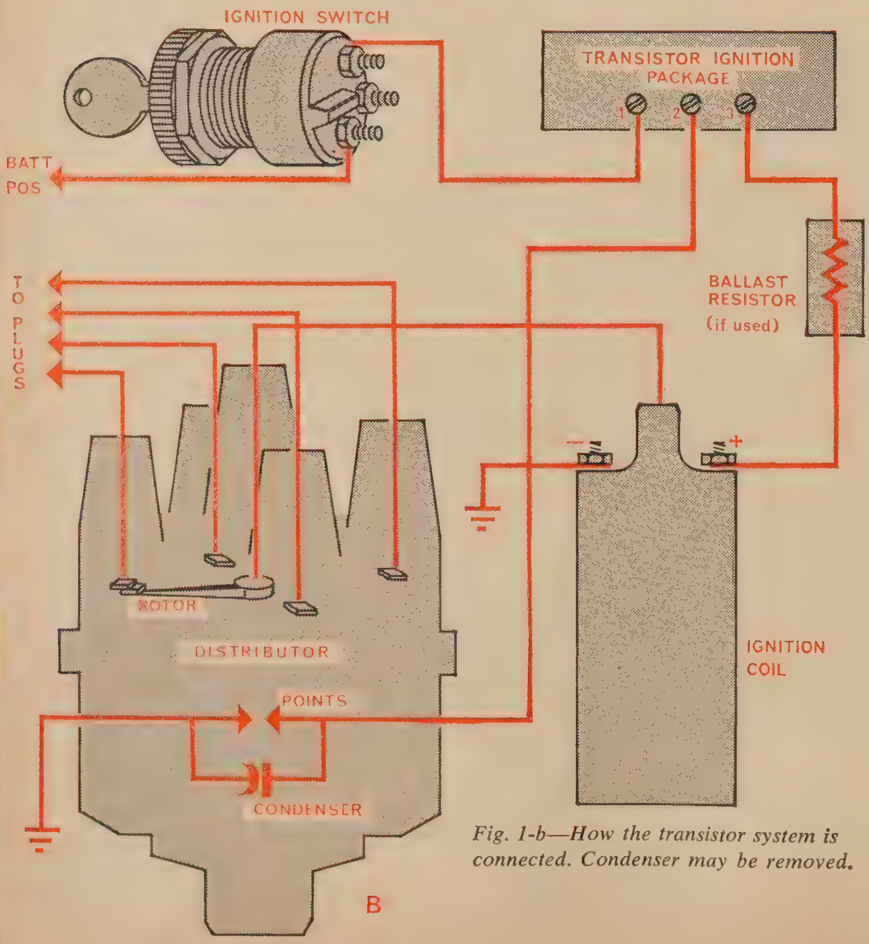

IGNITION SWITCH
TRANSISTOR IGNITION PACKAGE
1
2
3
BATT POS
TO PLUGS
BALLAST RESISTOR (if used)
−
+
ROTOR
DISTRIBUTOR
POINTS
CONDENSER
IGNITION COIL
B

Fig. 1-b—How the transistor system is connected. Condenser may be removed.

An editor of Radio-Electronics, who used William King's ignition system for 4,000 miles of driving in a 1960 Ford Falcon, reported:

"The unit works and works well. It's downright easy to connect—one bolt bracket mounting and three leads.

"Points clean and not eroded at end of test period. Plugs also fairly clean, but not as good as points.

"Gas economy up by about 2 mpg (this only when engine tuned after system installed). Acceleration and smoothness of engine seemed improved, especially on long upgrades with engine lugging.

"If I had the time, I'd probably build one of these for myself."

---

1. Connect point 1 to B-plus, point 3 to R, which goes to B-minus. Don't connect 2 to anything yet. The transistors should be off. Now adjust R5 and R6 alternately for equal voltage drop across the transistors (from collector to emitter).

2. Ground point 2 now (this turns on the transistors) and check to see if the drops across the transistors are equal and about 0.3 volt or lower. If they are not equal, adjust R1, R2 and R3. If they are equal but too high, decrease R4. This completes adjustment.

Now install the system in the car (Fig. 1).

1. *Select a cool location for the unit and mount it.*

2. *Refer to Figs 1-a and 1-b. Disconnect the lead from the negative side of the coil.*

3. *Trace the lead from the ballast resistor to the ignition switch. Disconnect the lead from the switch and connect it to point 3 on the transistor package terminal block.*

4. *Connect a lead from the switch terminal just freed to point 1 on the transistor package terminal block.*

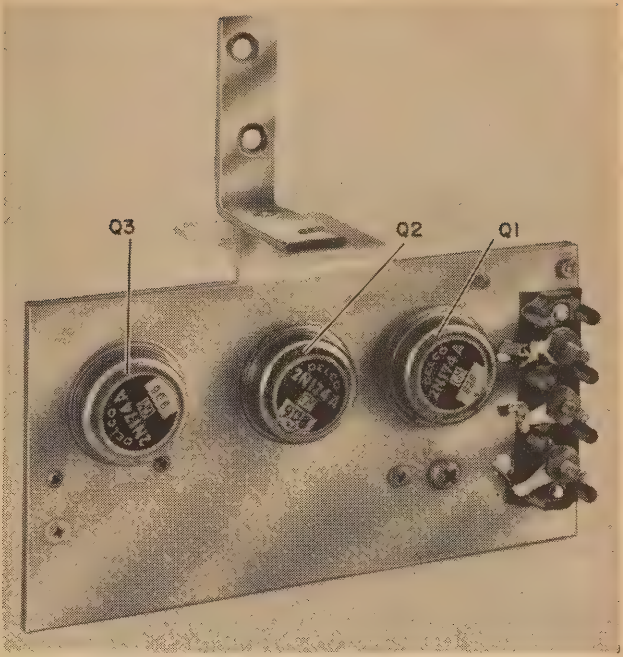
5. *Ground the lead from the negative side of the coil.*

6. *Connect the high side of the points to point 2 on the terminal block.*

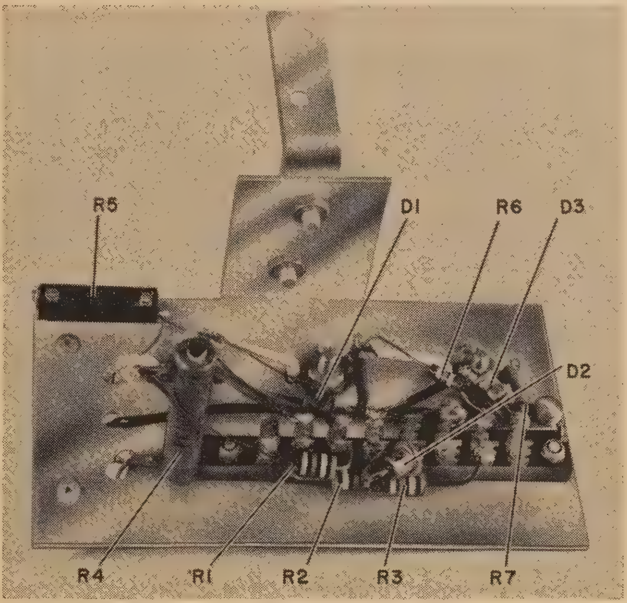
At this writing, the unit has been installed for approximately 1,000 miles each on a '59 Plymouth, a '58 Porsche, a '60 Chrysler 300 and a '61 Dodge. Driving conditions ranged from stop-and-go city driving through long high-speed trips including several desert crossings at temperatures above 100°. The waveforms are the same as they were when the equipment was installed and no parts have been replaced.

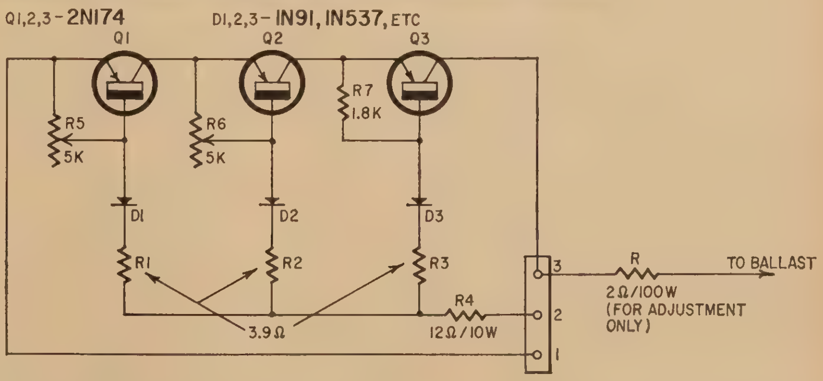
The Porsche has a 6-volt electrical system, and by reducing R4 to 5 ohms, the Zenerless ignition system worked just as well as on 12 volts. END

Aluminum 1/8 inch thick doubles as heat sink and chassis. 2N174-A collectors are common to cases, and must be insulated from heat sink with mica washers.



Circuit is easy and painless to wire. Watch diode polarities.

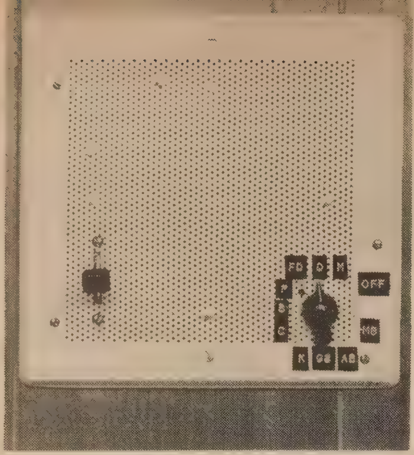




Circuit of Zenerless transistor ignition system.

D1, D2, D3—100 piv min., 150 ma germanium or silicon diodes (minimum ratings) (1N91, 1N537, —538, —539, etc.)
Q1, Q2, Q3—2N174 or 2N174-A (Delco, Motorola, RCA)
R1, R2, R3—3.9 ohms, 1 watt
R4—12 ohms, 10 watts
R5, R6—pots, 5,000 ohms (author used Bourns Trimpots, but ordinary carbon units are suitable)
R7—1,800 ohms, 1/2 watt
Aluminum sheet for heat sink and mounting bracket (see text)
Solder lugs, miscellaneous hardware

Super Communications Network For Your Home



One indoor station in author's system. Selector positions are Music, Den, Front Door, Patio, Basement, Conference, Kitchen, Guest Bedroom, Amy's Bedroom, Master Bedroom, and OFF.

Designed originally for fun, this fabulous intercom turned out to be as vital as a telephone system!

By ARTHUR SCHLANG

Looking for an intercom system for my new home, I couldn't find anything at a reasonable cost that met all my needs. Most available systems consist of a master station and a number of remote stations. A remote may communicate with another remote only through the master station. For a completely flexible communication system, you'd need a full-time telephone operator at the master station! Furthermore, I wanted to use transistors. So I designed an intercom system with these features:

1. Any internal house station can address any other station individually without going through a centrally located master station.

2. Any station can address all other stations simultaneously ("conference mode").

3. Any internal house station can switch so that it cannot be called either individually or in conference mode.

4. To assure privacy, no station can be arbitrarily monitored by another station.

5. All internal stations can switch to a "music mode" where any audio from a centrally located phonograph, FM–AM tuner or tape deck can be listened to. If a station is addressed while in the music mode, it automatically switches to an intercom mode and only the caller is heard. After completion of the call, the station reverts to music mode.

6. For economy, only one transistor power amplifier is used for the entire system. This doesn't limit usefulness, since the chance is small that more than one call will be made at the same time. In the unlikely event two calls from different stations are made simultaneously, the conversations are mixed and heard as one by two listeners, but at reduced volume.

Stations in the music mode lose music audio during any intercom conversation regardless of whether or not they are being addressed. No intercom audio is heard either, unless these stations are being addressed. If you object to that, you can build two identical amplifiers, one for the music mode and the other for all intercom modes.

7. Front- and back-door stations cannot select individual stations, but always address in conference mode.

8. The transistor amplifier is left on at all times.

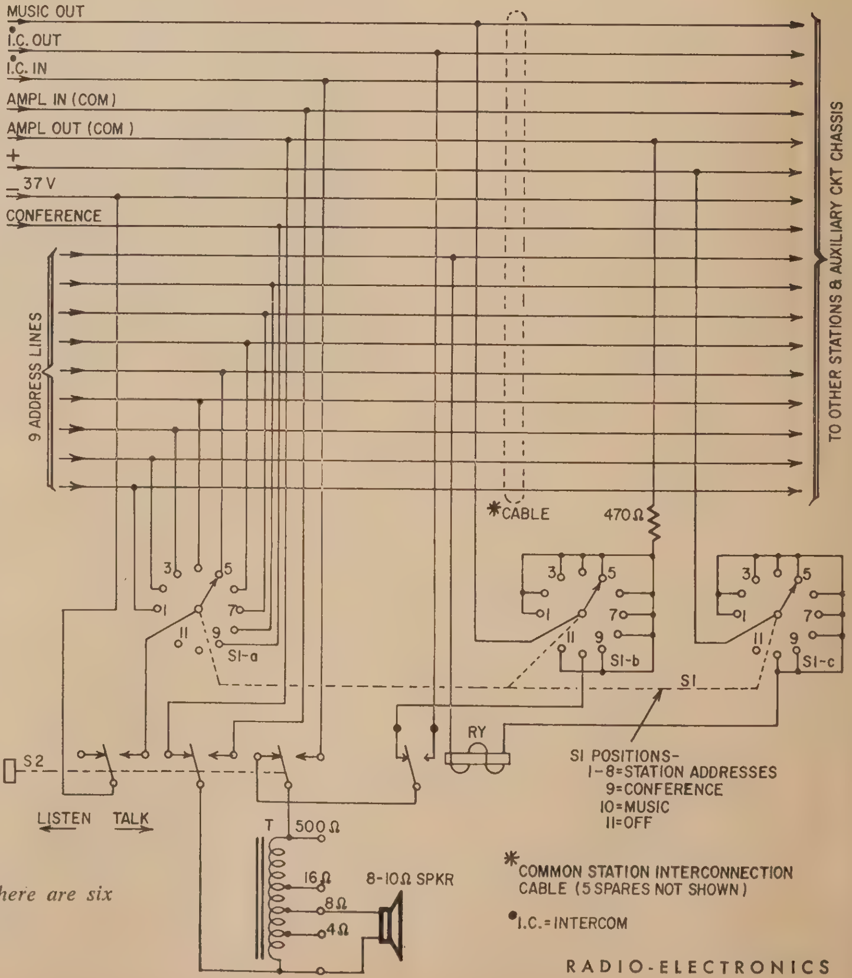

MUSIC OUT
•I.C. OUT
I.C. IN
AMPL IN (COM)
AMPL OUT (COM)
+
_37 V
CONFERENCE
9 ADDRESS LINES
TO OTHER STATIONS & AUXILIARY CKT CHASSIS
*CABLE
470Ω
S1-a
S1-b
S1-c
S1
RY
S2
LISTEN
TALK
T
500Ω
16Ω
8Ω
4Ω
8-10Ω SPKR
S1 POSITIONS-
1-8=STATION ADDRESSES
9=CONFERENCE
10=MUSIC
11=OFF
*COMMON STATION INTERCONNECTION CABLE (5 SPARES NOT SHOWN)
•I.C.=INTERCOM

Fig. 1—Complete circuit of indoor station. There are six others like it in author's system.

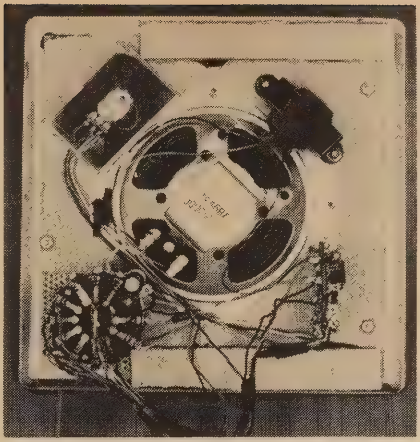
What it does

Each internal house station has an 11-position rotary switch. Eight of these positions select eight other stations for address. (There are nine stations in all in my house.) The ninth switch position selects the conference mode, the tenth the music mode, and the eleventh position is off.

A station can be called by another regardless of its switch setting, except in the off position. A spring-return push-to-talk key switch is also provided at each station.

To address another station, select that station with the rotary switch, then press the key switch to talk. The key switch must be released to listen to the reply. For privacy, a station cannot be monitored unless its key switch is depressed. In my baby daughter's room, however, a latch is arranged so that the key can be held down for baby-sitting. You can do the same thing in a sick-room application. Sensitivity is enough to pick up normal conversation at any point in a room.

To avoid confusion, always identify your station so that the addressee knows where to switch to answer. If you don't know a person's whereabouts, use the conference mode.



Inside one of the indoor stations.

Installing the system

Intercom wiring is best installed before wall and ceiling material is nailed on the studding of a new house. Wiring through completed walls is possible but difficult. I used cable containing eleven twisted pairs of No. 22 wire in a plastic sheath (Birnbach catalog no. 4711) run between all stations. This provides five spare wires for future modifications.

Rather than do the metalwork for each station myself, I used commercially available remote stations. They consist of a metal wall box with a removable front bearing a speaker and switch.

(The speakers and housings I used were bought a long time ago—I don't remember who makes them. They are not at all critical. Utah makes suitable baffles; try an MS3 with baffle housing ME3 for outdoors, and an MS5 with ME45 baffle housing for indoors. A suitable indoor speaker is the Utah SP-4A1; outdoors, the SP35A1. Nutone also makes a series of speaker-and-baffle combinations. Lafayette stock no. SK-209 is a weatherproof outdoor speaker with louvered enclosure. And you can always drill and punch ordinary aluminum chassis yourself. Any of the large electronics supply house catalogs should give you many suggestions.)

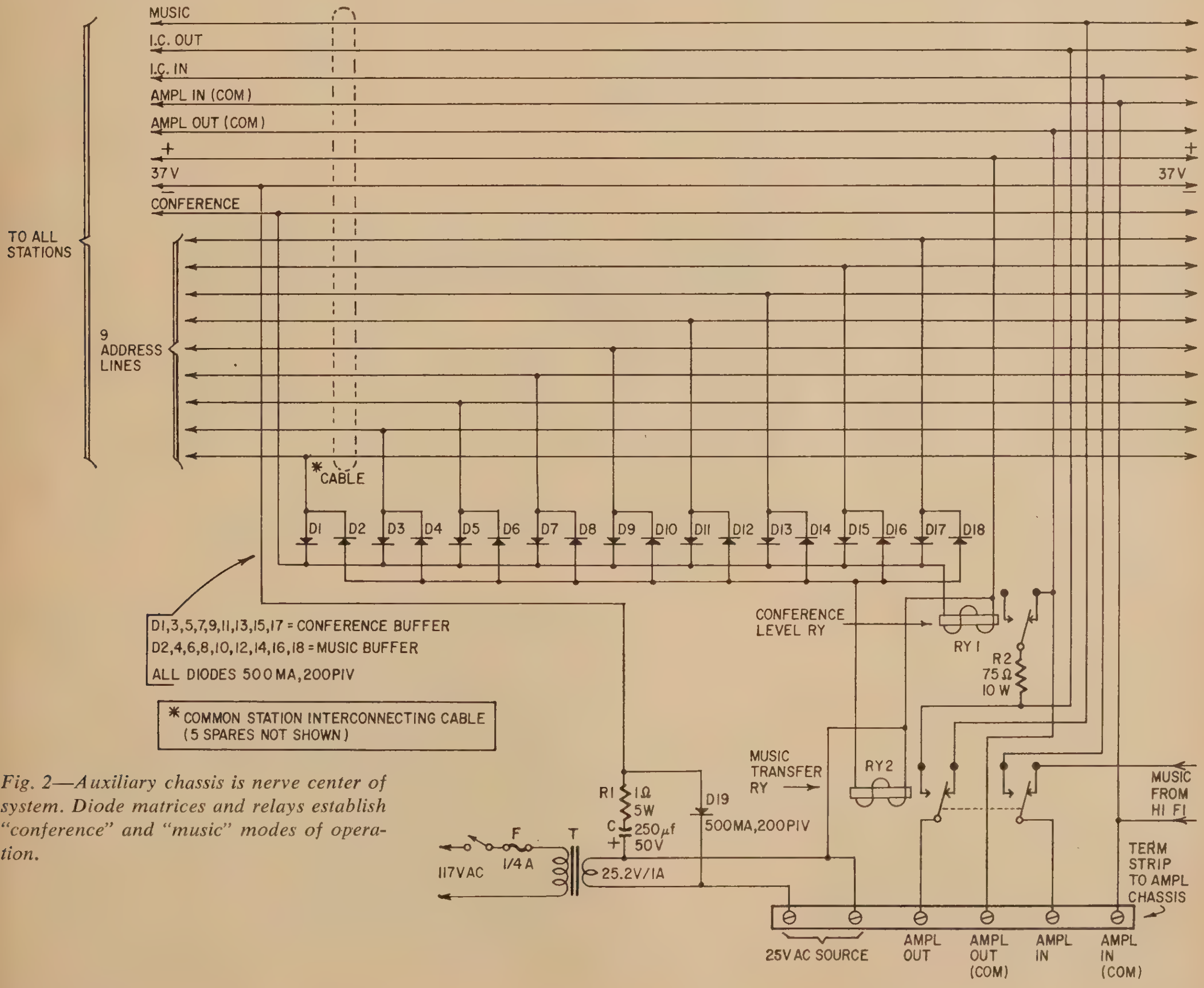

MUSIC
I.C. OUT
I.C. IN
AMPL IN (COM)
AMPL OUT (COM)
+
37V
–
CONFERENCE
+
37V
–
TO ALL STATIONS
9 ADDRESS LINES
* CABLE
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D1,3,5,7,9,11,13,15,17 = CONFERENCE BUFFER
D2,4,6,8,10,12,14,16,18 = MUSIC BUFFER
ALL DIODES 500 MA,200PIV
* COMMON STATION INTERCONNECTING CABLE
(5 SPARES NOT SHOWN)
CONFERENCE LEVEL RY
RY 1
R2
75Ω
10 W
MUSIC TRANSFER RY
RY2
R1
1Ω
5W
C
250μf
50V
D19
500MA,200PIV
F
1/4A
T
117VAC
25.2V/1A
MUSIC FROM HI FI
TERM STRIP TO AMPL CHASSIS
25V AC SOURCE
AMPL OUT
AMPL OUT (COM)
AMPL IN
AMPL IN (COM)

Fig. 2—Auxiliary chassis is nerve center of system. Diode matrices and relays establish "conference" and "music" modes of operation.

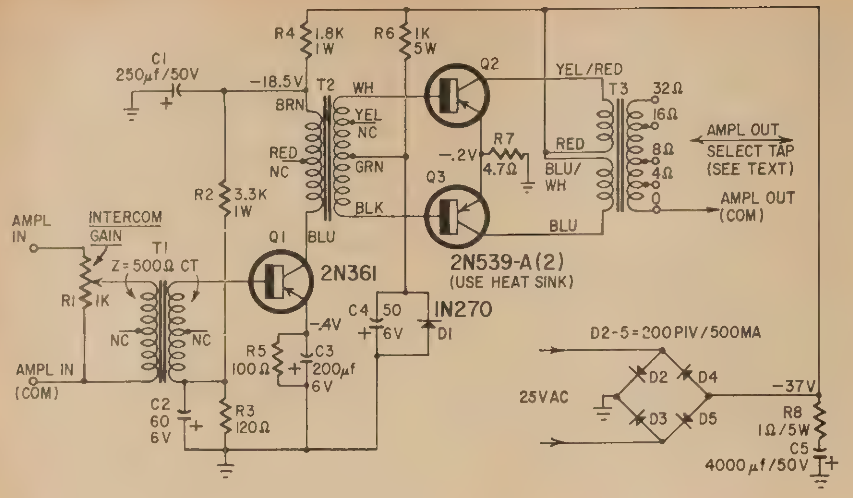


Fig. 3—Sole amplifier in system uses only three transistors, takes ac power from circuit in Fig. 2.

Parts List, Fig. 3

C1—250 µf, 50 volts
C2—60 µf, 6 volts
C3—200 µf, 6 volts
C4—50 µf, 6 volts
C5—4,000 µf, 50 volts
All capacitors electrolytic
D1—1N270
D2, D3, D4, D5—silicon diodes, 200 p.i.v., 500 ma (1N1693; Lafayette stock No. SP-197, etc.)
Q1—2N361 (Raytheon), 2N426, 2N427, 2N428 (Texas Instruments)
Q2, Q3—2N539-A (Honeywell—order through local Honeywell distributor or direct from Honeywell, 1177 Blue Heron Blvd., Riviera Beach, Fla. $12.35 each plus 8 oz. postage per pair. See text for alternates.)
R1—pot, 1,000 ohms
R2—3,300 ohms, 1 watt
R3—120 ohms, ½ watt
R4—1,800 ohms, 1 watt
R5—100 ohms, ½ watt
R6—1,000 ohms, 5 watts, wirewound
R7—4.7 ohms, ½ watt
R8—1 ohm, 5 watts, wirewound
All resistors 10% carbon except as noted
T1—transistor output transformer (used here as input transformer), 500 ohms ct primary to 500 ohms ct secondary (Argonne AR-162 or equivalent)
T2—Transistor output transformer (used here as driver transformer), 700 ohms ct primary to 4/8/16 ohms secondary—4-ohm tap used as ct (Thordarson TR-115 or equivalent)
T3—line-to-voice-coil transformer, 500 ohms ct primary to 2/4/8/16/32 ohms secondary (Triad S-77U or equivalent)
Chassis
Heat sink (depending on Q2, Q3 type)
Miscellaneous hardware

Parts list, Fig. 1

RY—spdt relay, 5,000-ohm coil (Lafayette F-260 or equivalent)
S1—3-section, 3-pole, 11-position rotary switch, nonshorting (Mallory 1331L or equivalent)
S2—3-pole, 2-position spring-return nonshorting lever switch (Centralab 1457 or equivalent)
T—line-to-speaker autotransformer, 500 ohms to 4/8/16 ohms (Triad S-66X or equivalent)

Parts list, Fig. 2

D1–D19—500 ma, 200 p.i.v. diodes (Lafayette stock No. SP-197, or equivalent)
C—250 µf, 50 volts, electrolytic
R1—1 ohm, 5 watts, wirewound
R2—75 ohms, 10 watts, wirewound
RY1—spdt relay, 5,000-ohm coil (Lafayette F-260 or equivalent)
RY2—dpdt relay, 5000-ohm coil (Lafayette F-332 or equivalent)
T—filament transformer, 25.2 volts, 1 ampere (Stancor P-6469 or equivalent)

I removed the original switch and installed the rotary and key switches as shown in the photos.

The auxiliary control circuitry and amplifier in my installation are wired on two chassis in a closet close to the hi-fi system so that music can easily be piped around.

How it all works

Each station contains a 5-inch 10-ohm PM speaker which serves either as a dynamic microphone or as a speaker. Each speaker is connected to a matching transformer to increase transmission and reception efficiency.

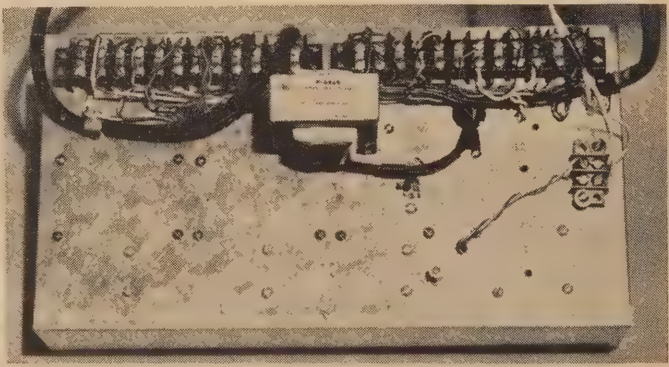
When the key (lever) switch, S2 in Fig. 1, is depressed, the now-microphone is connected through its transformer to two wires running to the amplifier input through the music transfer relay in Fig. 2. These two wires should be a twisted pair to minimize hum pickup by induction from power lines in the walls. When a station is addressed, and S1 in Fig. 1 is not set to OFF, the station's relay pulls in. This connects the now-speaker through its transformer through the undepressed key switch (S2) to two wires connected to the amplifier output through the music transfer relay in Fig. 2. This wire pair should also be twisted.

Amplifier input and output leads are isolated by transformers T1 and T3 (Fig. 3) to prevent feedback from common voltage drops in the long lines between amplifier and stations.

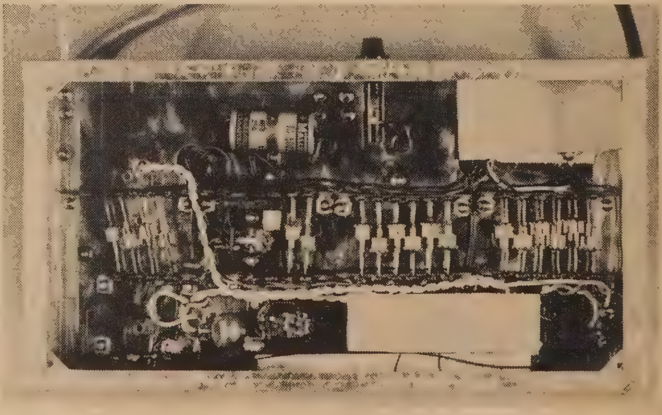
In Fig. 1, a third contact on S2 couples −37 volts to the arm of S1-a. Thus one of 10 lines is energized for address purposes when S2 is depressed.

Individual relays in each station are excited directly from one of nine lines. When the conference line, the tenth, is energized, all station relays are excited through the circuitry of Fig. 2. The diodes (D1–D17) in the conference buffer let the conference line energize all station relays, while energizing a single station line cannot energize any other station line because a diode blocks the current.

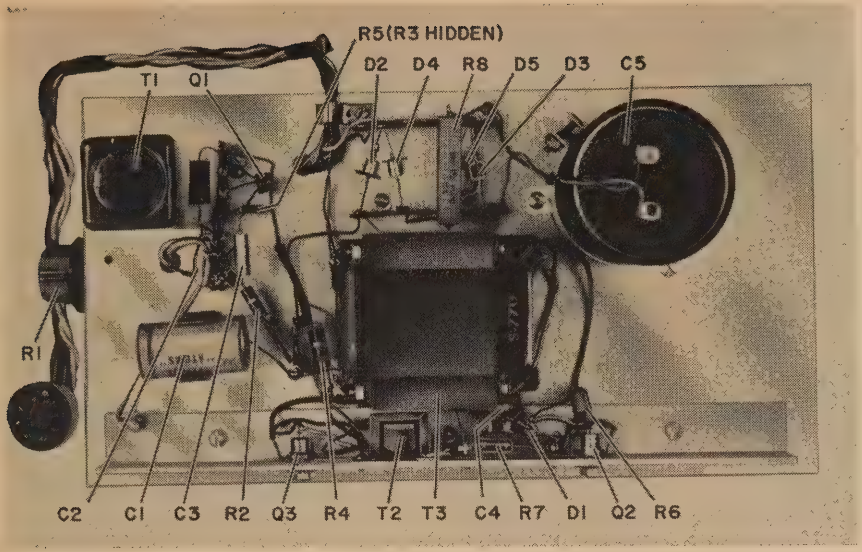
When the conference line is excited, level relay RY1 (Fig. 2) disconnects a 75-ohm dummy load resistor



The auxiliary chassis, which supplies power for entire system and contains diode networks.



Diode blocking networks are plainly visible here under auxiliary chassis.



Two-stage, three-transistor amplifier is common to all modes of operation. Output transistors are double-ended stud-mounting type, heat-sinked on aluminum angle stock at forward edge of chassis. Other case types can be used, but must also be appropriately heat-sinked.

from the amplifier output. This maintains a constant audio level in switching from an individual to a conference address. You may have to trim this value to meet your needs. Music buffer diodes (D2–D18) in Fig. 2 energize the music transfer relay RY2 when any or all of the station lines are energized. These diodes also isolate individual address lines from each other.

Music relay RY2 then transfers the amplifier input from music input to the microphone lines. The amplifier output is transferred from the music to the intercom output lines. When the music relay is energized, only those relays energized in each station (Fig. 1) can accept a call.

Deck S1-b in an individual station (Fig. 1) normally connects a 470-ohm resistor from the music line to the amplifier output common. When the switch is in the MUSIC (M) position, the 470-ohm resistor is removed from the circuit and the speaker with its transformer is connected instead. This puts constant resistive load on the music line whether a station is listening to music or not, and keeps constant signal level for all switch settings.

Deck S1-c prevents a station relay from becoming energized in the OFF position. You can omit that deck if you don't mind being interrupted.

Dc power for all relay circuitry is developed by the small power supply in Fig. 2. Dc is used for control because the diode buffers must be correctly polarized, and to keep hum level down. The same transformer is used for amplifier power.

All the relays are inexpensive units distributed by Lafayette Radio, catalog No. F-260. Check that a small air gap is left between pole piece and armature when the relay is energized, or it may not drop out when power is removed. These relays have 5,000-ohm coils, so that even when all are energized simultaneously, power consumption is negligible. They come packaged in individual plastic cases. Leave the cases on when you mount the relays, for protection.

At front- and rear-door stations, there are no rotary switches, so all calls are in the conference mode (Fig. 4). Music is always on unless a spare music line is used for these two stations. This line can then be switched off at the amplifier.

The amplifier

The transistor amplifier is straightforward. Be sure to mount the output transistors on heavy heat sinks. They are operated in class-B and can develop 15 watts.

The 2N539-A transistors used in the output stage (Q2, Q3) cost $12.35 apiece from the manufacturer, Minneapolis-Honeywell. Two less expensive substitutes (in the diamond-shaped TO-3 package) are the 2N511-B, made by Bendix and Texas Instruments ($6.35) and the 2N375 (Bendix and Motorola, $4.10). These two alternate types are available from Newark Electronics Corp., 223 W. Madison St., Chicago 6.

Another way to beat the cost is to use a separate, lower-voltage power supply for the amplifier, making it possible to use output transistors with a lower breakdown rating (almost any of the old standards, like the 2N255, 2N-301, 2N301-A, 2N554, 2N1501, etc.). All that that requires is to use a separate power transformer (Stancor P-8130, 12.6 volts ct at 2 amps, for example) with the same rectifier and filter components shown in Fig. 3, to give a supply of about 18 volts. With that lower voltage, omit R4 in Fig. 3 (1,800 ohms) and change R6 to 470 ohms, 2 watts.

A universal audio output transformer included in the amplifier permits matching to various impedance lines.

END

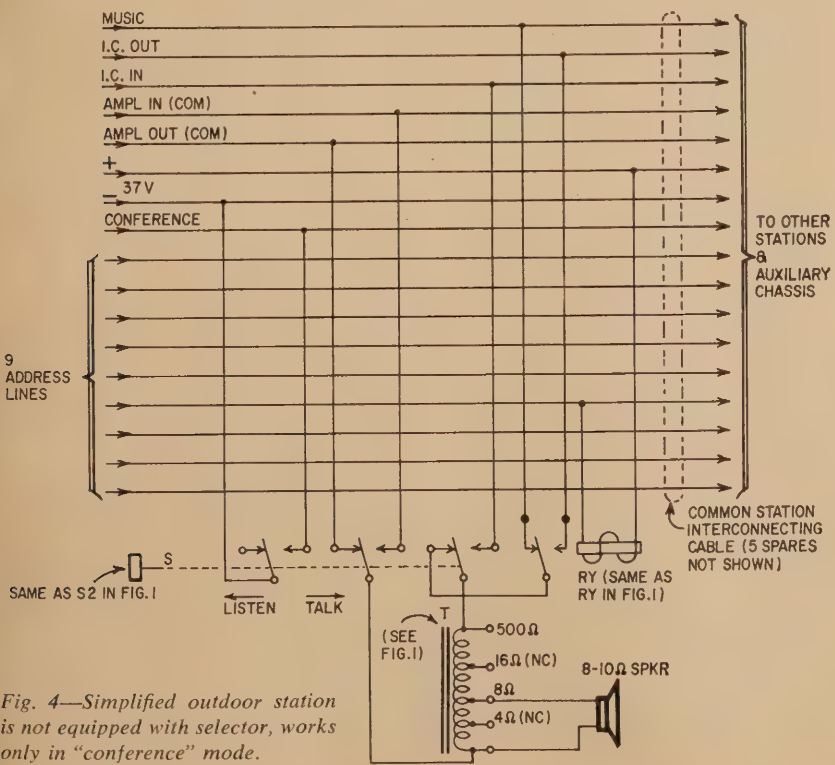


Fig. 4—Simplified outdoor station is not equipped with selector, works only in "conference" mode.

Boonton Q meter type 190-A

Boonton uhf Q meter, model 280-A

ONE OF THE MOST VERSATILE INSTRUMENTS YOU'LL EVER USE, THIS ONE BELONGS BY THE SIDE OF YOUR VTVM

USING THE Q METER

By **DONALD E. BOWEN**

ALMOST EVERYONE KNOWS THAT THE Q, or figure of merit, of a tank circuit determines its selectivity. But that isn't the whole story. Many circuit parameters are determined by the tank-circuit Q: an oscillator's stability, the efficiency of a transmitter final, or the gain of an rf amplifier. And many circuit parameters determine the operating Q of a tank circuit: stray capacitance, connecting leads, amount of dc, and vacuum-tube plate resistance, to name only a few.

But the chore of determining the Q of a tank circuit accurately is just a little too much for the trusty grid dipper or the workbench signal generator. How, then, is Q measured?

Just as there are voltmeters to measure voltage and ohmmeters to measure resistance, there are Q meters to measure Q. And the very nature of the Q meter makes it one of the most versatile and useful rf test instruments in the workshop or lab. The meter is not restricted to rf, but works well into the audio range. You can use it to test audio chokes, transformers and video peaking coils. A Q meter can measure circuit Q, inductance and capacitance; or determine power factor, phase angle, losses in dielectric material, rf resistance, distributed capacitance, mutual conductance, and coefficient of coupling. The list goes on and on. Not only that, but it can be used as a signal generator, an absorption wavemeter or a relative field-strength indicator.

How it works

In understanding how the Q meter works, you may find Table 1 a help. You've probably seen these relationships before—they're generally known, and you'll find more complete explanations in most electronics texts. Keeping them in mind it will be easier to see how the Q meter works.

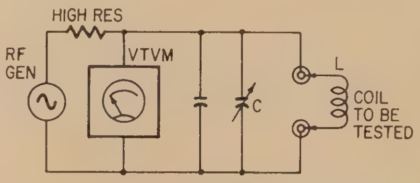


Fig. 1—"Susceptance-variation" method of measuring Q. Not the most accurate, it is seldom used commercially.

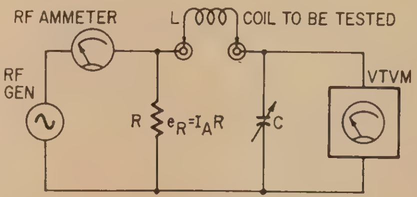
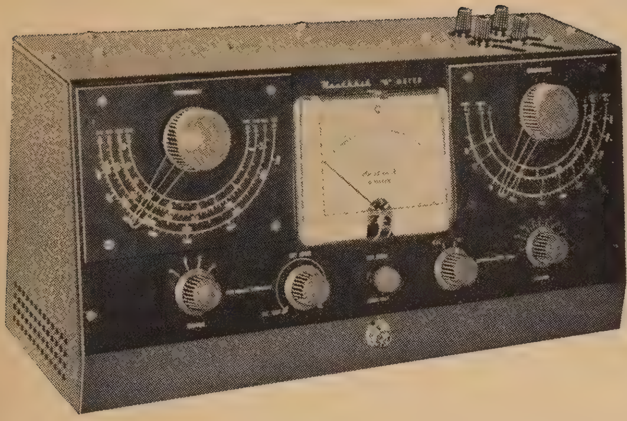


Fig. 2—"Circuit-magnification" Q-measuring technique. This is the foundation for most commercial systems.

The Q meter is made up of a calibrated oscillator, an injection circuit, a test mount for the circuit being tested and a high-impedance metering circuit. Two basic arrangements are commonly used for connecting the test circuit together. The less common of the two, shown in Fig. 1, is the *susceptance-variation* method. Fig. 2 shows the more common method: the *circuit-magnification* method.

The circuit of Fig. 1 depends on the *change in impedance* of a parallel-resonant circuit as it is tuned away from resonance. Test circuit LC is loosely coupled to the generator. Either the *delta-C* or *delta-F* method (delta, the Greek letter Δ, is short for "change in . . .") of measuring Q can be used, depending on which is easier. Usually the delta-C method is used, the dial on capacitor C being set up so that the Q may be read direct.

In the circuit-magnification arrangement (Fig. 2), the rf oscillator applies a signal across the terminals of series-resonant circuit LC. The injection voltage is determined by measuring the rf current through resistor R. This resistor is small compared to the resistance of the circuit being tested (usually about



Heath model QM-1 Q meter

Marconi TF1245 Q meter connected to separate oscillator (left).

.05 ohm). The current is measured by the thermocouple ammeter. Variable capacitor C is located in the Q meter, and coil L is connected to jacks on the meter.

When the series circuit is tuned to resonance (or when the generator frequency is tuned to the resonant frequency of the LC circuit), the impedance between input and ground is low and a large current flows in the series-resonant circuit. Because of the high current, large out-of-phase voltages are generated in C and L. The voltage across C is measured by a high-impedance vtvm.

According to one of the basic Q relationships (Table 1), $Q = \frac{E_X}{e_R}$. Thus, the voltage across C (measured by the vtvm) divided by the voltage across R (a known value) is the circuit Q, which may be read directly from the vtvm (calibrated in Q units).

A variation of the basic circuit-magnification method is shown in Fig. 3. Notice that no ammeter is used. The signal generator looks like a constant-current source. The output voltage is monitored and is held constant. It is applied to a small series capacitor (C_a), connected to injection capacitor C_b. The value of C_b is very large compared to resonant-circuit capacitor C, so that the current is constant for practical cases.

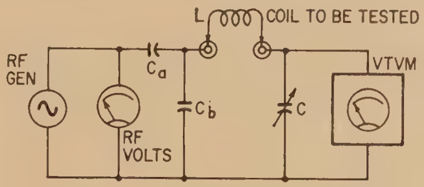


Fig. 3—A variation of the magnification method. This is the actual basic circuit of several Q meters on the market.

TABLE 1. BASIC Q RELATIONSHIPS

$Q = \frac{X_L}{R_S} = \frac{X_C}{R_S}$	where R_S is the equivalent series resistance, X_L is the inductive reactance, X_C is the capacitive reactance.
$Q = \frac{R_P}{X_L} = \frac{R_P}{X_C}$	where R_P is the equivalent parallel resistance.
$Q = \frac{f_0}{f_2 - f_1} = \frac{f_0}{\Delta f}$	where f_0 is the resonant frequency and f_1 and f_2 are the half-power points on the resonant curve.
$Q = \frac{E_X}{e_R}$	where e_R is the in-phase voltage and E_X is the reactive voltage across L or C.
$Q = \tan \phi = \frac{1}{\cot \phi}$	where ϕ is the phase angle.
$Q = \frac{2C_0}{C_2 - C_1} = \frac{2C_0}{\Delta C}$	where ΔC is the change in capacitance necessary to tune from the lower half-power point through resonance to the upper half-power point.

Note: Some of these relationships are approximate, but accurate within 1% for Q values above 7.

Except for the use of the voltmeter–voltage-divider arrangement, this circuit is the same as that described in the previous paragraphs.

In vhf and uhf instruments, inductances are often used instead of capacitors C_a and C_b, L_a being a large inductance and L_b being an extremely small one.

Commercial Q meters

Fig. 4 is a schematic of the Heathkit Q meter, model QM-1. The circuitry is typical. The 12AT7 is a variable-frequency rf oscillator with a cathode-follower output. The basic meter movement and the crystal diode monitor the output voltage. The rf signal is coupled to the test circuit (450-pf capacitor, 7-pf vernier and test jacks) by a 7–35-pf trimmer and a special .005-μf injection capacitor. The vtvm uses a 12AU7, a 6AL5 and the basic meter movement. Power supply is included, so that the unit is self-contained.

In the photograph of the Heathkit unit, note that capacitance and inductance scales are are included on the large dial on the right so that it is possible to read Q, capacitance and inductance values.

In addition to these common features, the Boonton instruments pictured can measure extremely low Q values, with meters designed to eliminate viewing parallax, thus allowing extremely accurate readings. One of the Boonton instruments, the 280-A, is designed especially for uhf. It has the additional feature of being able to measure components in-circuit and can measure the extremely high Q's of resonant cavities.

Additional flexibility has been incorporated in the Marconi TF-1245. Here, the Q meter contains no internal oscillator. Any oscillator capable of driving the unit may be used. The photograph shows the TF-1245 connected to a Marconi TF-1247 utility oscillator.

The Q meter (like any electronic instrument) can be only as good as its operator. It is a simple device, but you must be careful to make correct adjustments and to take accurate readings. Let's go over a few measurements that show how versatile a Q meter can be. Note that, although control names and markings vary with particular makes and models, general terms are used in the instructions below. And remember, there is no substitute for the instruction manual supplied with the equipment.

Measurements on coils

Measuring Q. The fundamental and obvious use of the Q meter is to measure Q. The most common method is direct-reading, which works like this:

1. Connect the coil to the coil terminals.

2. Adjust the Q-meter capacitance to the desired value (depending on the frequency at which you want to examine the Q).

3. Set the Q-meter oscillator to the proper range.

4. Set the "times Q" reading to some convenient whole-number value.

5. Tune the Q-meter oscillator until you hit resonance—maximum reading on the Q vtvm.

6. Carefully readjust all settings, taking care to balance the vtvm.

7. Read Q by multiplying the "times Q" setting by the Q vtvm reading.

Check reading by measuring the change of capacitance necessary to bring the Q vtvm reading from 0.707 of maximum *below* resonance to 0.707 of maximum *above* resonance (these are the upper and lower half-power points of the resonance curve.) These values are substituted in the formula $Q = \frac{2C_o}{\Delta C}$. Values of C must be taken very carefully for this measurement.

Inductance. Although most Q meters contain a calibrated inductance scale, it's often useful to understand the method used to determine the inductance.

1. Resonate the coil at the desired frequency.

2. Read the frequency.

3. Read the value of capacitance that resonates the coil.

4. Substitute the values in the formula $L = \frac{1}{\omega^2 C}$, where $\omega = 2\pi f$.

If the distributed capacitance of the coil is important, the term C becomes the sum of the Q-meter capacitance reading and the distributed capacitance. You can determine the distributed capacitance this way:

1. With the coil connected to the Q meter, adjust the Q-meter capacitor to some low value. Call that value C_2.

2. Resonate the tuned circuit. Call this frequency f_2.

3. Tune the Q-meter generator to $f_1 = \frac{1}{2} f_2$.

4. Reresonate the tuned circuit, calling the new value of capacitance C_1.

5. Substitute those values in the formula $C_D = \frac{C_1 - 4C_2}{3}$.

Mutual inductance and coupling coefficient. These measurements are related and are conveniently made together. They should be made at or near the same frequency.

1. Measure the inductance of each of the coils separately, calling the two values L_1 and L_2.

2. Measure the total inductance L_a with the coils in series aiding.

3. Measure the total inductance L_b with the coils series opposing.

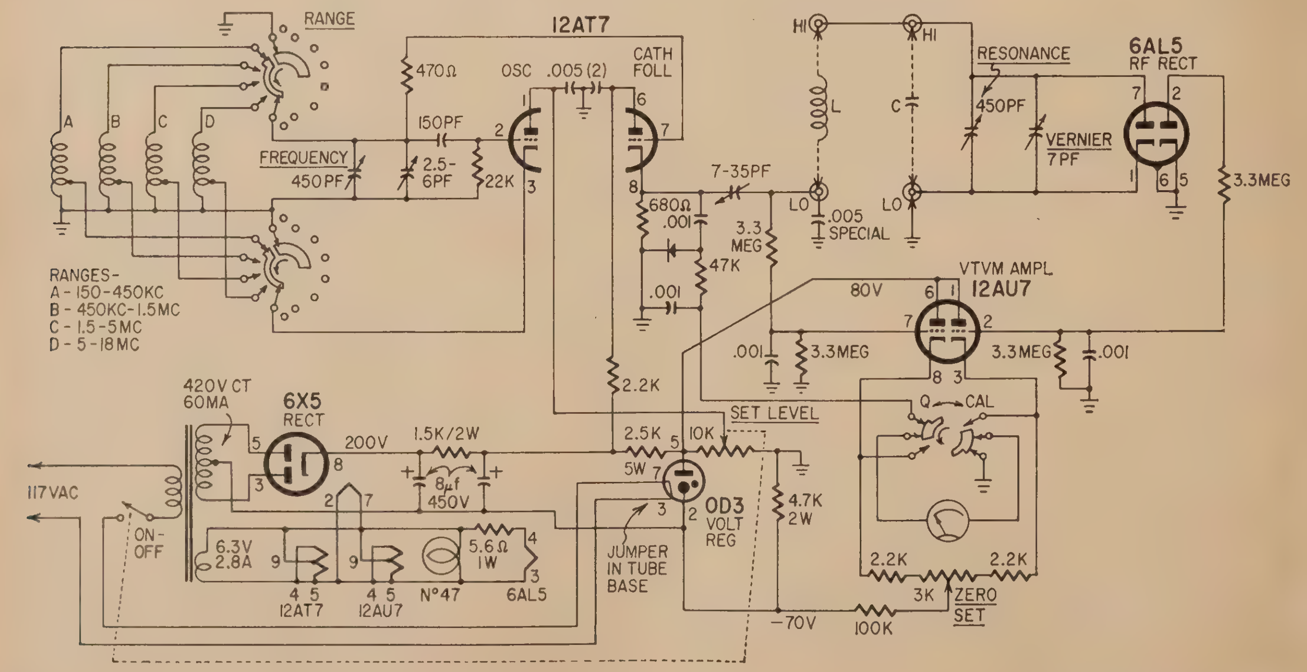
4. Substitute in the formulas $M = \frac{L_a - L_b}{4}$ for mutual inductance and $K = \frac{L_a - L_b}{4\sqrt{L_1 L_2}} = \frac{M}{\sqrt{L_1 L_2}}$ for coefficient of coupling.

These inductance measurements represent a few of the coil tests you can make with a Q meter. There are many more. For example, the gain of coupled circuits can be measured and large inductors (even in the audio range) can be measured, to mention only two other applications.

Capacitance measurements

Two types of capacitance measurements can be made on the Q meter: **series** and **parallel.** Series measurements are used to determine values of capaci-

Fig. 4—Circuit of the Heath QM-1, a relatively typical Q meter.


RANGE
12AT7
470Ω
OSC
.005 (2)
CATH FOLL
150PF
FREQUENCY 450PF
2.5-6PF
22K
A
B
C
D
RANGES-
A - 150-450KC
B - 450KC-1.5MC
C - 1.5-5MC
D - 5-18MC
7-35PF
680Ω
.001
3.3 MEG
47K
.001
HI
L
C
LO
.005 SPECIAL
RESONANCE
450PF
VERNIER 7PF
6AL5
RF RECT
3.3MEG
VTVM AMPL
12AU7
80V
.001
3.3MEG
3.3MEG
.001
2.2K
420V CT
60MA
6X5
RECT
200V
1.5K/2W
8μf 450V
117VAC
ON-OFF
6.3V 2.8A
5.6Ω 1W
12AT7
12AU7
N°47
6AL5
2.5K 5W
10K
SET LEVEL
OD3 VOLT REG
JUMPER IN TUBE BASE
4.7K 2W
Q
CAL
2.2K
2.2K
3K
ZERO SET
-70V
100K

tance greater than the value of the Q meter's variable capacitor. Parallel measurements are used to measure small capacitors. This is the procedure for parallel measurements:

1. Connect a coil across the coil terminals on the Q meter.

2. Connect the unknown capacitor across the capacitor terminals of the Q meter.

3. Adjust the Q meter capacitor to some low value, C_1.

4. Tune the Q-meter generator to resonate the circuit. (Do this at the lowest possible frequency, to minimize the effect of lead inductance of the unknown capacitor.)

5. Remove the unknown capacitor.

6. Tune the Q-meter capacitor until the circuit is again resonant. The new value of capacitance is C_2.

7. Determine the value of the unknown capacitor:

$$C_x = C_2 - C_1.$$

Series capacitance measurements.

1. Connect the unknown capacitor between the low side of a coil and the low terminal of the Q meter.

2. Adjust the Q-meter capacitor to some high value C_2.

3. Tune the Q-meter generator to resonate the circuit (again at the lowest possible frequency to minimize the effect of lead inductance).

4. Short out the unknown capacitor with a short piece of heavy wire.

5. Reresonate the circuit by tuning the Q-meter capacitor to a new value, C_1.

6. Determine the value of the unknown capacitor by the formula

$$C_x = \frac{C_1 C_2}{C_2 - C_1}.$$

Besides these fundamental capacitance measurements, it is possible, among other things, to determine phase shift of capacitors and to evaluate dielectric materials.

Other uses

The Q-measuring circut of a Q meter contains an rf vtvm, a variable capacitor and terminals for connecting a coil to resonate with the variable capacitor. If an unshielded coil is connected to the terminals with the internal signal generator disabled, and the Q meter is placed near an active rf circuit, its circuit may be tuned to the frequency radiated by the rf circuit. Resonance is indicated by a deflection of the Q-meter vtvm. You can then measure the frequency of the active rf circuit by disabling it and adjusting the Q-meter rf generator to the meter's tank-circuit resonance point. Read the resonant frequency off the generator frequency dial.

Q meters are being used to measure the parameters of semiconductor devices, characteristic impedance, velocity factor and loss in transmission lines.

Many Q-meter accessories are available from manufacturers; you can make others. Test coils and calibrating devices are among the most common accessories. Special test fixtures for measuring dielectric materials can extend the usefulness of the meter. Optical magnifiers, to permit more accurate scale readings, can be built or purchased.

A few precautions

The Q meter, in general, operates at rf. For that reason, components to be tested must be connected to the Q meter with short leads to insure maximum accuracy. Lead length becomes increasingly important at the higher frequencies.

Unshielded coils being measured on a Q meter are subject to stray rf fields, coupling to nearby resonant objects (even power cords or light bulbs!) and variations due to the proximity of your hands. If you can't eliminate these effects by locating the test circuits properly, use a large, grounded shield over the coil being tested.

All quality Q meters have internally regulated power supplies. In extreme cases it may be necessary to use line-voltage regulating transformers to keep the supply voltage within allowable limits. Extreme line-voltage variations may have a pronounced effect on the stability of the instrument.

Watch your grounds—make them to a common point. Keep contact resistance at the test-coil terminals as low as possible. Make your measurements in an area where stray rf signals are at a minimum, and where coils under test are not coupled to nearby objects. Keep your hands away from the coil under test. Check instrument setup (meter balance, etc.) periodically.

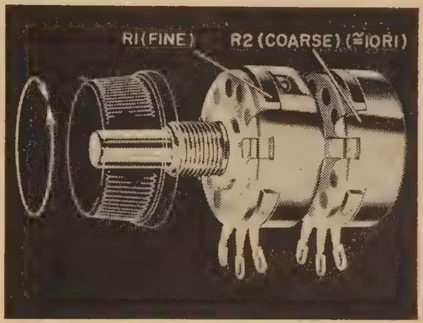
This fabulously versatile instrument can be bought as a kit or ready-made. Prices range from less than $60 to several hundred. Occasionally, a good Q meter hits the surplus market—for instance, when a manufacturer goes out of business or updates his equipment. Then you can buy one for a small fraction of its original price. Any way you do it, it's an instrument worth having!

END

References

The BRC Notebook, Boonton Radio Corp., Boonton, N. J.: No. 1, Spring 1954; No. 4, Winter 1955; No. 8, Winter 1956; No. 13, Spring 1957; No. 16, Winter 1958; No. 27, Winter 1961; No. 28, Spring 1961.

Potentiometer Features Built-in Vernier



"Built-in backlash" is the term used to describe the working of this ingenious new variable resistor developed by the Allen-Bradley Co. Looking just like any ordinary ganged dual potentiometer, the Type JJV incorporates a deliberately "sloppy" coupling between front and rear sections to permit fine, high-resolution adjustments for zeroing meters, nulling bridges, or any other application where critical touch-ups of resistance are necessary.

The front section (R1) is normally made with the same taper as the rear section (R2), but with about 1/10 the resistance. As you begin to rotate the knob from its extreme counterclockwise stop, only R1 moves. About 40° from the stop, you "pick up" the R2, which until then has been idling in its notched coupling device. The shaft attached to R1 then drags the R2 wiper along, and you continue turning until you reach a meter reading (or scope indication, etc.) just *beyond* the value you want.

Overshooting the mark this way makes it necessary to turn the shaft back the opposite way to come down to the desired value. As you do so, the drive releases the coarser rear section, R2, and only the front section R1 is in the circuit. Because (in a rheostat-type connection) it is in series with R2 but only a small fraction of the value of R2, it can "trim down" the value very neatly. If you start from the clockwise stop, the coupling works the same way, but reversed. In other words, it works equally well in either direction.

If you continue turning after you reach the desired value, eventually you will again pick up the coarse section and ultimately return it to the end stop.

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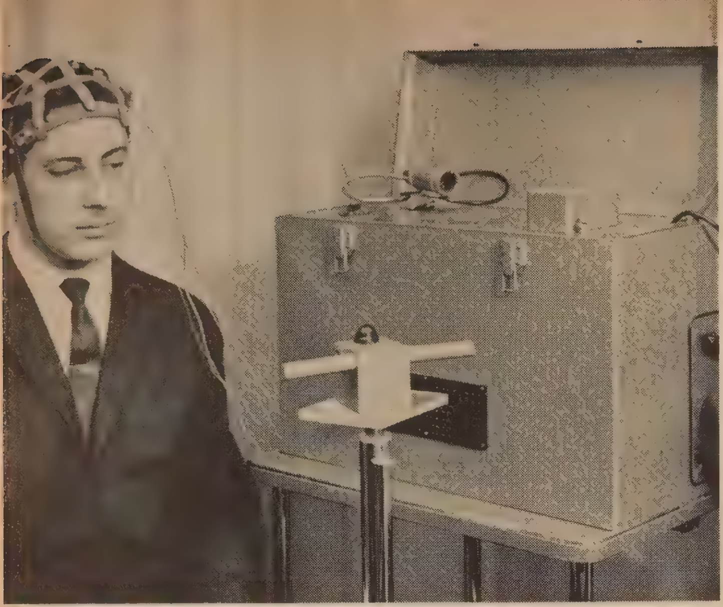

The experimental setup used by M. Dusailly.

Psycho-Command and Psycho-Reaction

By J. F. DUSAILLY*

IT IS POSSIBLE, BY CONCENTRATING THE WILL, TO ACTUATE A REMOTE MECHANISM

CEREBRAL ELECTRICITY WAS DISCOVERED by an English physiologist, Caton, in 1875: electrodes inserted into the brain of a trepanned ape recorded currents readable on a galvanometer. In 1929, after extensive research, Hans Berger demonstrated that the brain is a seat of electric oscillations and that mental activity modifies their amplitude and frequency.

The waves produced by the brain of a subject in physical and mental repose are called *alpha waves*. Their length is enormous (between 23,000 and 43,000 kilometers). Their frequencies vary from 7 to 13 cycles, and their amplitude from 5 to 50 microvolts (Fig. 1). Other waves (beta, delta, theta, gamma) have different amplitudes and frequencies.

The *electroencephalograph* supplies curves that represent the resultant of these brain waves. To analyze these curves and separate them into their components is an extremely delicate and to some extent subjective operation. Attempts have been made to produce results by mathematical (Fourier analysis) or physical (electric filter) methods. These are based on the hypothesis that the brain waves to be separated are originally perfectly sinusoidal. This, however, has not yet been demonstrated in practice.

The combination of a cerebral electrocartograph with an electronic computer promises great progress in this domain. Such an instrument has been placed in service in the hospital of Salpetriere. It is designed to furnish an automatic representation of the space–time distribution of the brain's electric activity.

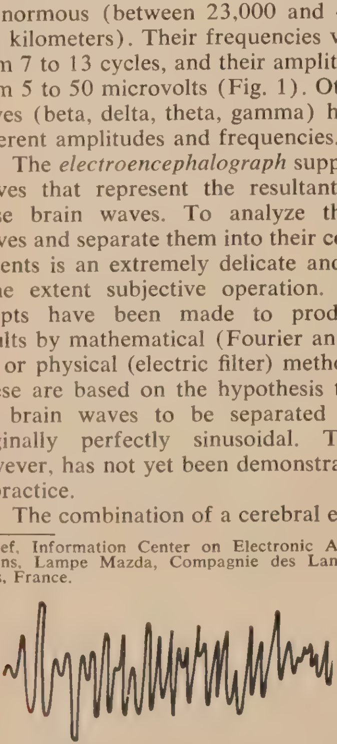

Fig. 1—Appearance of normal alpha-wave rhythm.

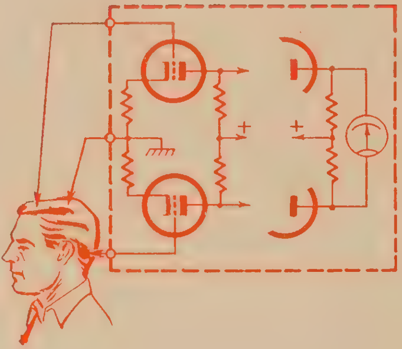

Fig. 2—How the electrodes are placed to amplify brain waves.

How are brain waves obtained?

The pickup devices for brain waves are silver electrodes applied to the scalp. It is not necessary to remove the hair. A pad, soaked with salt water and held in place with a rubber cap, makes a reasonably good contact. The placement of the electrodes and the excellence of the contact are important. The contact can be improved by using a conducting paste applied by massaging lightly into the skin in the area where the electrode is to be applied.

The voltages are weak, in the order of some dozens of microvolts. Unless a Faraday cage is used, it is necessary to shield the subject from surrounding fields—50 cycles created by the electric light lines [these experiments were made in France], atmospheric and industrial electricity, high-frequency transmitters, etc.

The 50-cycle field is particularly annoying, because it can produce signals of the same order as those from the brain. To guard against the influence of everything that doesn't come from cerebral activity, a *differential amplifier* is used. It is sensitive to differences of potential between two neighboring points of the skull, but not sensitive to voltage variations common to the two points.

These voltages are taken between a neutral electrode, usually placed at the top of the skull, and two other electrodes, which may be variously situated (Fig. 2). The neutral electrode is connected to the ground (chassis) of the amplifier and to an excellent external ground. The amplifier must be excellently shielded.

In spite of all precautions, some stray signals do superimpose themselves on the alpha waves. These exist at various frequencies: the slowest due to movements of the head or eye, to unbalance in the connecting wires of the electrodes, and to some extent to voltages caused by cardiac activity. The highest frequencies can be produced by electromyograms (signals due to muscle movement.) [See "Electromyography" by Dr. Bernard Post, RADIO-ELECTRONICS, issue of November 1960.]

To eliminate the lowest-frequency

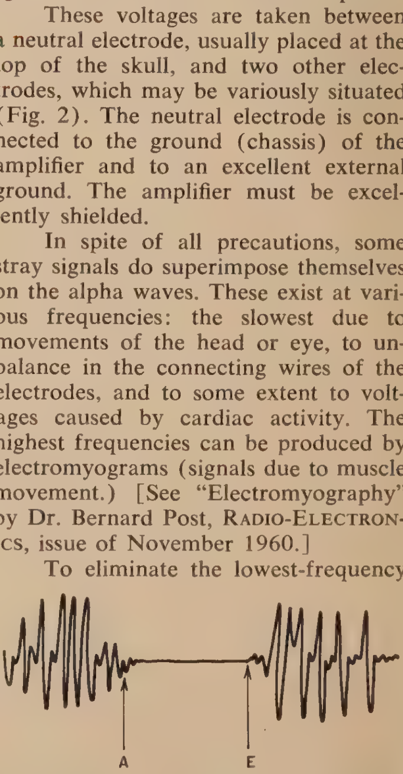

Fig. 3—Brain activity (between A and E) cuts down the size of the alpha waves.

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*Chief, Information Center on Electronic Applications, Lampe Mazda, Compagnie des Lampes, Paris, France.

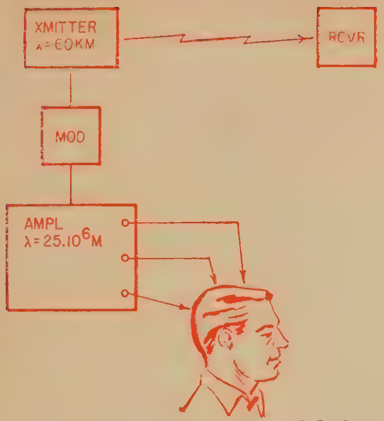

Fig. 4—Brain waves are amplified and used to modulate a transmitter which actuates a relay at the receiver.

undesirables, it is necessary to use circuits with a suitable time constant. The most practical is to utilize those employed in electroencephalography — 0.1, 0.3 and 0.7 second.

The amplitude of the alpha wave is maximum—in the order of 30 to 50 μv—during physical and mental repose. If the subject concentrates, the amplitude of the alpha waves diminishes due to the action of the brain (Fig. 3). Our experiments in psycho-control use this variation of the brain waves.

Principles of psycho-control

Until now, waves emitted by the brain have produced no outside effect other than recordings on an electroencephalograph. We thought it might be possible to utilize these waves to control a mechanism (though the alpha waves are very weak—in the order of picowatts—and cannot produce any direct mechanical action at a distance).

To actuate a mechanism, the brain-wave voltages would have to be amplified considerably, then used to operate a sensitive relay to finally produce the desired reaction.

We arrive, therefore, at the general scheme of Fig. 4.

The waves are picked up by the electrodes on the head of the subject and amplified to the limit permitted by present techniques. The amplitude of these waves varies when the subject passes from mental repose to the cerebral activity required by the concentration of his will. These variations modulate very long electromagnetic waves.[1] These waves are under the control of the subject's will and produce the desired action. In our experiments, we were able to light or extinguish a small lamp at a distance, but of course it would be equally easy to control any other type of mechanism.

Let us make it completely clear that psycho-command is based on the *electromagnetic* transmission of cerebral activity and must not be confused with what one habitually refers to as transmission of thought (telepathy). Nevertheless, this experiment has created great interest among students of metaphysics. They feel that this is the first step in reducing the gap between pure science and metaphysical research.

Psychological reaction

Our experiments are especially delicate because they depend to some extent on the psychological state of the subject. One of the conditions for success is that he be a party to the experiment and be persuaded that it is likely to succeed. If he has any doubts, he will probably not be able to concentrate his will sufficiently.

A number of experiments over several months have already made it possible to come up with several interesting conclusions. Not only is there the possible action of the brain on a mechanism, but also a reaction of the mechanism on the brain—feedback.

As long as we are dealing with an "all or nothing" reaction (light the lamp or extinguish it), naturally the critical threshold of sensitivity depends to some extent on intangible conditions. This creates a certain anxiety in the subject—he fears he may not be able to light the lamp. If, on concentrating his will, he sees the lamp shine for only an instant, he is reassured by the success of the experiment and finds it very easy to keep the lamp lit. There we have a general psychological feedback reinforcing the input signal (the order given to the subject to light the lamp).

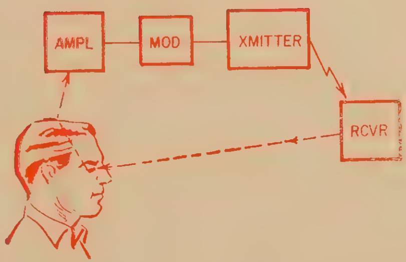

Fig. 5 — The brain–amplifier–transmitter–receiver–brain cycle of the action and feedback.

If, for any reason, the subject is *not* able to light the lamp with his will, the psychological feedback may actually make it impossible for him to concentrate sufficiently. The lamp, then, cannot be lit. This reaction is strikingly similar to that of electronic amplifiers.

Fig. 5 shows the analogy between the man–mechanism complex and a purely mechanical servomechanism.

This discovery of psychological reaction (feedback) will almost certainly assist progress in pychological studies.

END

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[1] The long wavelength (60 km) was chosen to avoid all risk of interference from radio waves or electric fields.

AC-DC Radio Voltages: Pretty Constant From Set to Set

THERE ARE AT LEAST SEVERAL TRILLION AC–DC radios in this country (or so it seems!) and vast numbers of them need servicing. One encouraging observation is that these sets are pretty well standardized and their voltages, too, fall into general patterns. After considerable experimenting and study, I've found that voltage facts applicable to most AC–DC receivers can be summarized as:

With no signal, the rf grid of the converter tube, the grid of the i.f. amplifier tube, and the diode plates (when they are used as such; one is sometimes connected in another way) should show about −1 volt or less with respect to B-minus. A signal—at least, a strong one—should increase this voltage.

The oscillator grid of the converter tube usually reads between −6.5 and −12 volts.

The grid of the first audio tube should show about −1 volt.

These points operate at 0 volts: suppressor grids, the audio output tube grid, the cathode of the converter tube and the cathode of the first audio tube. In many sets, especially older ones, the cathode of the i.f. amplifier operates at 0 volts but it will show a slight positive voltage if there is a cathode resistor.

Positive voltages should always be found at these points: The plates and screen grids of the converter and i.f. amplifier tubes—usually between 80 and 100; the plate of the first audio tube—usually between 35 and 60; the audio output cathode—usually between 5 and 7; the screen grid of the audio output tube—usually between 80 and 100; the audio output—usually between 95 and 120; the rectifier cathode—usually between 110 and 125.

A person familiar with the layout of a radio can take all these measurements in a short time. With the voltmeter set for 150 volts, positive, check off the plates and screen grids and the rectifier cathode. That takes care of the rectifier. Switch to 50 (or 15) volts and catch the audio output tube grid and cathode. With the same setting, you can check the other cathodes and the suppressor grid or grids. Switch polarity and check the converter grids, (rf and oscillator) the i.f. amplifier grid, the diode plates and the grid of the first audio tube.

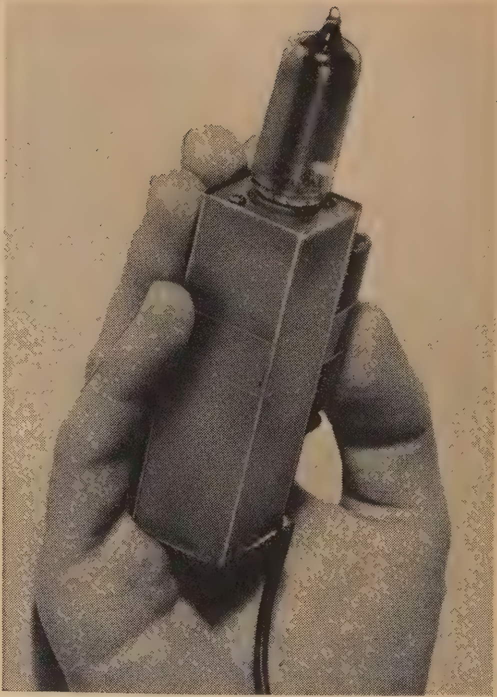
Use either a vtvm or a 20,000-ohms-per-volt tester. In either case, expect a variation of 10% from the accepted voltage standard.—*Philip Lacy*

ADD A SUPER-SELECTIVE MECHANICAL FILTER

Like to pick up Rome on 845 kc, between US broadcasters on 840 and 850? If so, read on!

By R. E. BERGE

COVER STORY



HAVE YOU EVER TUNED IN A WEAK DX station on your broadcast or short-wave receiver, only to have a powerful adjacent-channel station surge in and blot it out just as the announcer began to speak? Even reasonably good communications receivers have trouble on short-wave bands today. With so many new high-power stations the separation between broadcast stations is only 5 kc (sometimes even less) compared with the 10-kc separation on the medium-wave broadcast band.

Adding a Q-multiplier or a crystal filter will improve selectivity greatly, but these usually only narrow the peak of the i.f. response curve, leaving the sides as they were (curves A and B in Fig. 1). They are most useful for CW reception.

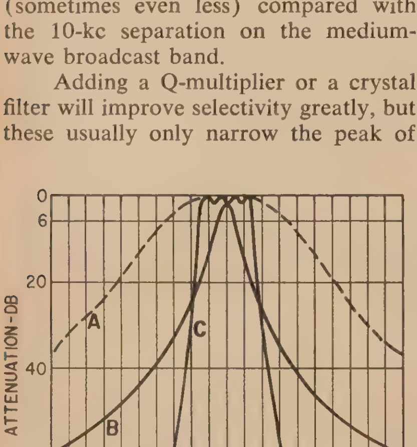


Fig. 1—Contrast between normal AM broadcast receiver i.f. curve (A), sharper, steeper communications receiver curve (B) which attenuates audio sidebands severely, and unique mechanical filter curve (C), with its flat top and extremely steep sides.

A much greater improvement is possible by replacing the 455-kc input i.f. transformer with a *mechanical filter*. Unlike conventional couplings made up of L and C elements, these filters closely approximate the flat-topped, steep-skirted ideal bandpass response (curve C in Fig. 1).

You may be taken aback at the idea of modifying your receiver to the tune of $30 to $50. But if you can make an $89 receiver as selective as one in the $300 class, it's well worth while.

Mechanical filters are made of a series of small resonating nickel-alloy discs of extremely high Q—8,000 to 12,000. A complete filter consists of a magnetostrictive transducer (to convert electrical oscillations into mechanical oscillations and back), the mechanically resonant discs and disc coupling rods.

A signal sent through the transducer coil creates a magnetostrictive effect in its core. The core, attached to the resonant discs, alternately elongates and shortens, causing the discs to vibrate at their resonant frequency. Frequency of vibration is determined by the physical size of the discs and coupling rods. A second transducer at the far end of the assembly converts the mechanical movement back to electrical variations (Fig. 2-a). The effect is that of an elaborate multisection L-C filter (Fig. 2-b).

Wiring one of these filters into a typical receiver involves major surgery even though the filter itself is only about the size of a K-Tran i.f. transformer. So I looked into the idea of an adapter that could be plugged into the first i.f. tube socket, without any wiring change in the receiver.

An experimental adapter was built using a battery-powered transistor to compensate for the 10-db loss of the mechanical filter. It worked so well with a Hammarlund HQ-100 that this article is the result.

Connecting the adapter is simple. Remove the first i.f. tube in the receiver and insert it in the socket atop the adapter. Then plug the adapter into the vacant tube socket in the receiver. This inserts the adapter between the first i.f. transformer and the first i.f. tube (at point X in Fig. 3).

Circuit

The output of the mechanical filter is series-tuned and coupled to the base of the standard transistor i.f. amplifier. The only trick to the amplifier is the coupling of the grid to the i.f. tube. Here a vacuum-tube type i.f. transformer might be used with reasonably good results if space is available. The transistor amplifier in the model unit uses a cup-core coil (L) in the collector circuit.

The cup-core is a miniature Ferroxcube type 3C with a single-section bobbin. The winding consists of 100 turns of No. 36 enamel-coated magnet wire tapped at 40 turns from the bottom end. The parts list with Fig. 4 gives detailed parts information. A toroid coil of similar design would also be satisfactory. The inherent self-shielding characteristic of the ferrite cup-core and of the toroid

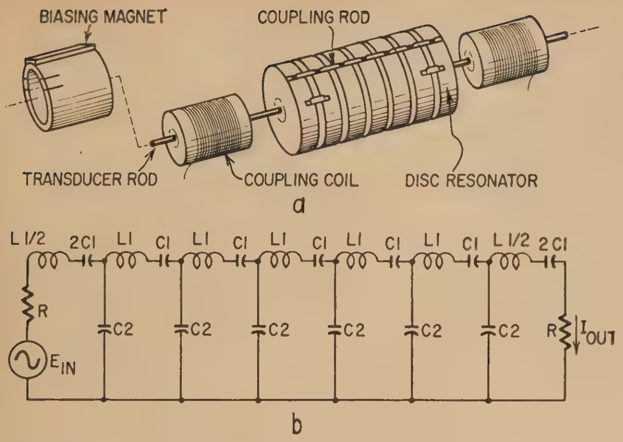


Fig. 2-a—Exploded view of Collins mechanical filter. Magnetostrictive drive from one coil is transmitted through discs via transducer and coupling rods. Coil at other end reconverts mechanical energy to electrical energy and sends it on to next amplifier stage. In (b), electrical analog of mechanical filter.

make them most satisfactory for this circuit.

The crux of the whole story is that the path of least resistance to the i.f. signal *must* be from the input pin on the adapter plug, through the mechanical filter, through the transistor amplifier, through the vacuum tube in the adapter socket, and back to the output pin on the adapter plug. Any stray coupling by other routes will reduce the filter's effectiveness. The mechanical layout may be similar to the one shown or you may arrange it according to your tastes, as long as you provide proper shielding to prevent leakage or feedback around the mecahnical filter or transistor amplifier.

The secondary of the first i.f. transformer in your receiver is designed to have a high impedance so that it will match the high impedance of the following tube grid circuit. This makes it ideal for coupling to a mechanical filter, which, when parallel-tuned, wants to "see" approximately 100,000 ohms. Normally a 130-pf capacitor will tune the filter, but peaking the tuning capacitance for maximum signal at 455 kc will usually yield better performance.

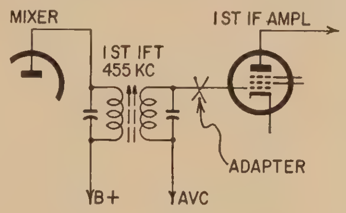


Fig. 3—Where the adapter goes, electrically.

The mechanical filter can be made to match a low-impedance load by series-tuning the output with about the same-value capacitor as that used for parallel

The author sent us one of his adapters to try with several different kinds of receivers. First it was plugged into a National NC-88 all-wave receiver. It worked very well. Next we tried it on an old Fisher 50-R-2 FM-AM broadcast tuner, and had quite a surprise. We found signal-free spots betwen regular AM broadcast channels 10 kc apart. As we tuned, we found a station about midway between 1460 and 1470 kc. We knew it couldn't be a US or Canadian station, since our frequency allocations are at even 10-kc multiples.

When the music stopped, the announcer began speaking—in French. It turned out to be Radio Monte Carlo in Monaco! Our first European station on the AM broadcast band! Checking in the **World Radio TV Handbook**, we found that Monte Carlo is on 1466 kc, with 400 kw power.

Then we began hunting between US channels in earnest. A few evenings of listening in December (1963)—usually between 5 and 8 pm and occasionally from 11:30 pm to 1:30 am EST—brought positive identification of London on 1214, 1295 and 647 kc, Rome on 845 and Lisbon on 755 kc.

Others heard but not positively identified were BBC stations on 908, 1088 and 1457 kc, Voice of America in Munich on 1195, French stations at Lille on 1376, Bordeaux on 1205, Toulouse on 944 and Nancy on 836 kc. Note that all these are between normal North American channels. Without the adapter, the weak European stations were buried by the strong US and Canadian stations a few kilocycles away. The receiving location was suburban New Jersey, about 25 miles from Times Square.

The adapter's 3- or 4-kc selectivity proved its worth on the shortwave bands also, with the NC-88. The receiving location was only 7 miles from the powerful Voice of America transmitters at Bound Brook, N.J., which normally blanket 15 to 20 kc on either side of their frequency on ordinary receivers. With the adapter, it was possible to pick out weak stations only 10 kc away. With just normally-strong stations, it was no trick to pick out weak ones only 5 kc away. Background noise and heterodyne squeals were greatly reduced also, because of the narrow bandwidth.

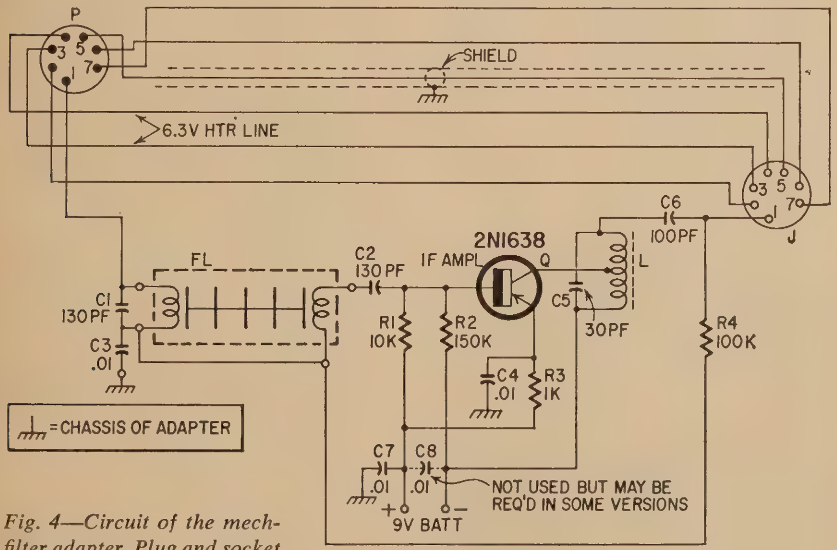


Fig. 4—Circuit of the mech-filter adapter. Plug and socket wiring shown is for 6BA6 and similar 7-in. miniature tubes.

C1, C2—130 pf
C3, C4, C7, C8—.01 μf, 200 volts (Aerovox P83Z or equivalent)
C5—30 pf mica or ceramic
C6—100 pf
FL—Collins mechanical filter (type F455Y-31 or F455FB-21—see text)
J—tube socket to fit receiver's existing first i.f. tube
L—cup-core coil: 100 turns No. 36 enameled, tapped 40 turns from low end. Core is Ferroxcube 332 P 133 B4-3C (2 pcs. required, 40¢ each). Bobbin, Ferroxcube 332 F 175 (1 required, 6¢ each). Order from Ferroxcube Corp. of America, Saugerties, N.Y.
P—plug to fit existing first i.f. tube socket in receiver (Vector P7, P7A or equivalent)
Q—2N1638 (RCA)
R1—10,000 ohms
R2—150,000 ohms
R3—1,000 ohms
R4—100,000 ohms
All resistors ¼ watt, 10% tolerance
BATT—9-volt battery (RCA 216 or equivalent)
Case—see text, Fig. 5 and photograph

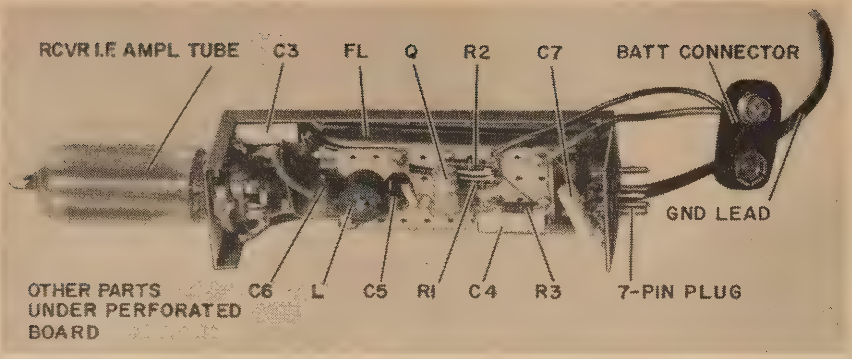


Fig. 5—Internal construction of adapter. Modifications are possible, but follow suggestions in text.

tuning. This capacitor also should be tuned for maximum signal at 455-kc. Series-tuned, the filter is a nearly ideal impedance match for the low-impedance transistor input.

Note that a dc path is provided in the adapter circuit to allow uninterrupted avc bias control on the grid of the i.f. tube. The lead used to connect the plate terminal of the socket to the same terminal on the plug should be shielded, with the shield tied to the adapter chassis. Use a twisted pair for the heater connections. All interconnecting leads between the plug and the socket are run in a shielded duct alongside the filter and amplifier sections of the adapter. An additional bypass capacitor may be necessary on the socket end of the screen interconnecting wire.

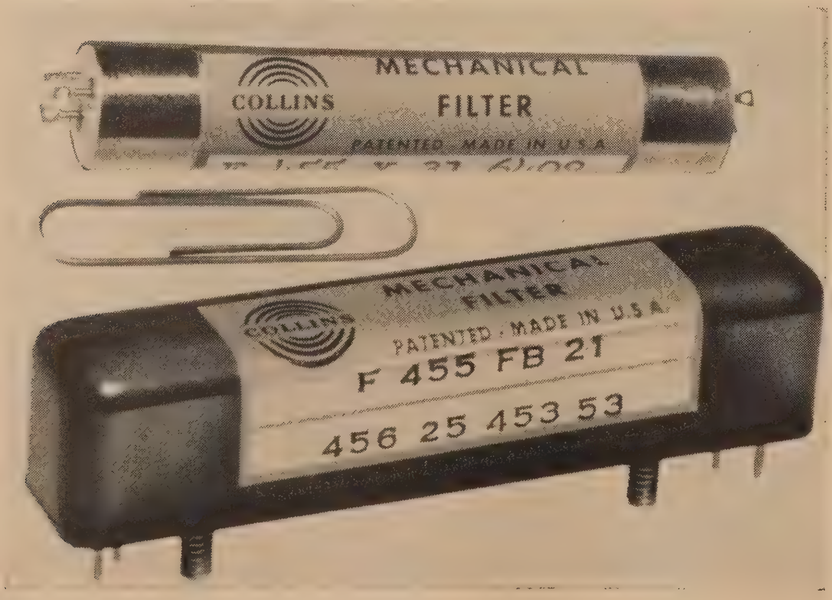
All bypass grounds are to the adapter chassis. The chassis, in turn, is grounded to the receiver chassis through a wire soldered to the adapter chassis. An alternate way is to connect the adapter chassis to the grounded heater lead. This won't work with a transformerless (ac-dc) receiver, and, in any case, you'll always have to check to see which heater lead is grounded in case you use the adapter in other receivers.

A type F455Y-31 mechanical filter, available from the Components Div. of Collins Radio Co., Newport Beach, Calif., or from Collins distributors, for $38 plus tax and postage, was used in the model adapter. The new plug-in type F455FB-21 (available only with 2.1-kc passband, and physically slightly larger) is also usable and can be bought direct from Collins or through distributors. Price postpaid from Newport Beach is $26.50. All resistors are ¼-watt size. Tuning capacitors are miniature Aerovox type P83Z.

Construction

The circuit of the adapter is shown in Fig. 4. Before building it, check your receiver to determine the tube in the first 455-kc i.f. stage. If it is a 6AU6, 6BA6 of 12BA6, a seven-pin plug and socket will be required in the adapter. (This is the type used on the unit shown.) If it is a 6SK7, an octal plug and socket will be required. Measure the space available in your receiver to determine suitable outside dimensions for your plug-in unit.

Two forms of the Collins magnetostrictive mechanical filter used in the adapter.



Cut out and bend a piece of brass or copper sheet stock similar to the mounting bracket in Fig. 5. A socket and base plug similar to the type in your receiver's first i.f. stage are mounted in the bracket ends. The inner shield, also sheet copper or brass, is cut and mounted in such a position that it will isolate the mechanical filter and transistor amplifier circuit from the interconnecting wiring.

The unit shown in Fig. 5 and on the cover was designed to plug into the smallest practical space, such as the first i.f. stage of the HQ-100 receiver. The outside dimensions are 1 x 1 x 3½ inches. In many cases, especially where the receiver uses octal tubes, more space is available. Small plug-in chassis with socket and plug attached, such as the ones manufactured by Vector Electronic Co., Glendale, Calif., are commercially available at most radio supply stores and may be a more convenient housing for the adapter. In all cases, the short lead from the grid pin of the plug to the parallel tuning capacitor on the mechanical filter input should be decoupled as much as possible from the other leads to the plug by a well located inner shield.

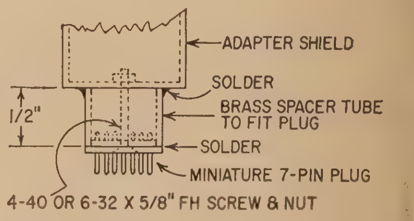

ADAPTER SHIELD
SOLDER
1/2"
BRASS SPACER TUBE TO FIT PLUG
SOLDER
MINIATURE 7-PIN PLUG
4-40 OR 6-32 X 5/8" FH SCREW & NUT

Fig. 6—Modification to bottom of adapter to make it fit tube sockets with integral shield bases. If tube was shielded, use shield-base socket for tube at top of adapter (J in Fig. 4)

Since the filter is $2\frac{3}{16}$ inches long plus terminals, the adapter is 3½ inches long with maximum squeeze. If your receiver will not permit this additional height, the tube socket might be mounted at right angles to reduce effective height. Or build the unit with an extension cable between the adapter and the seven-pin (or octal) plug.

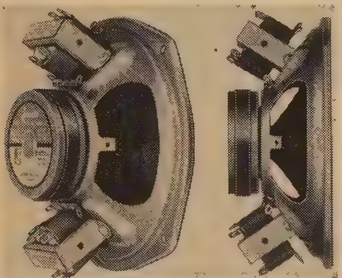
The extension will permit you to locate the adapter in a convenient spot in the receiver. The cable lengths should not exceed about 6 inches and the extension plate and grid leads must be shielded. Use low-capacitance cable, such as Belden 8421. Ground the shielding to the receiver and adapter chassis. Six inches of this cable has a capacitance of 8 to 10 pf. Since this is in parallel with C1 (130 pf) which tunes the input of the mechanical filter, you may have to reduce C1's value by about 10 pf if you use the extension.

[If the i.f. amplifier tube in the set has a shield base, you may have to extend the adapter plug mounting as in Fig. 6. Also, you may have to shield the tube when you plug it into the filter adapter. However, shielding was not needed in any set in which we tested the adapter.—*Editor*]

Current drain of the amplifier is approximately 2 ma, so the life of a 9-volt transistor radio battery is very long. The battery should be mounted in a cool position, away from hot tubes or the power transformer. An on–off switch for the transistor amplifier may be mounted in a convenient spot, if desired.

After plugging the adapter into your receiver, be sure to peak up the tuning on the other i.f. stages to resonate exactly with the mechanical filter (its tuning is fixed at precisely 455 kc). If the i.f. in your receiver is more than 5 kc off, you may have to retrack the receiver's oscillator also, following the receiver service notes.

In an adapter of this type, it is not often possible to come up with perfect matching at all points in the circuit. This circuit is a practical happy medium with the transistor amplifier designed only to make up for the loss in the filter. You may be able to improve on it by winding a special transformer for coupling between the transistor output and grid output or in some other way. The price of a filter, about $5 worth of other parts, and some of your own construction ingenuity will make that old receiver really sit up and talk. END



"Dual Channel Access" Loudspeakers

Two output transformers on one speaker? Something new. Each works with a separate voice coil in the speaker. Thus one amplifier can be hooked up for regular program use, and another for special announcements, emergency signals, regular time signals (as in a school), or other special uses. For use by non-technical people, this type of speaker solves the switching problem beautifully —by eliminating it! The speakers are made by Jensen in two models, both with 8-ohm voice coils. They are available with transformers for 70- or 25-volt lines.

Better Scope Transistor Checker

By ROBERT G. WARNER

I BUILT AN INSTRUMENT LIKE THE ONE Daniel F. Smith described on page 32 of the May 1963 issue of RADIO-ELECTRONICS, and cataloged all my loose and occupied transistors.

But I found that adding an audio sine-wave generator to Mr. Smith's circuit makes it more useful.

With the generator, I can find out how the transistors behave at higher frequencies, and I have a way of measuring approximate transistor gain without using the slope of the trace on the scope screen.

Fig. 1 shows how I marked off the slope screen with slopes corresponding to gains of 10 through 60. Setting the scope gain controls for a slope of 20 with the same signal applied to the vertical and horizontal inputs allows direct reading of gain. If I set the controls under those conditions for a slope of 10, I have to multiply my slope readings by 2, which lets me work with higher-gain transistors.

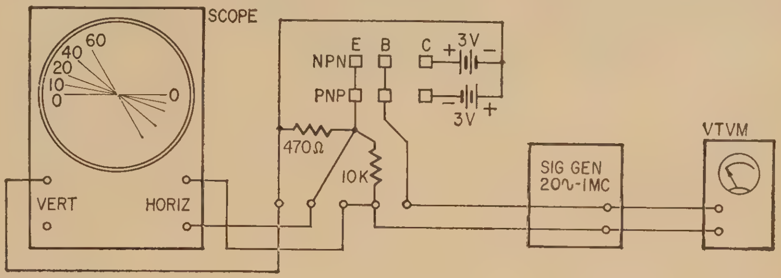


Fig. 1—Connections and scope markings.

If the battery voltage is constant, I can get an approximation of the gain by measuring the voltage applied by the signal generator that is needed to produce only that part of the trace between "knee" and "instep", as shown in Fig. 2.

In other words, by adjusting the output of the generator we can find out how much signal is required to cover the complete amplifying range of the transistor. This signal, with constant battery voltage, should be about inversely proportional to gain. With a dc voltage of 3.1 and a signal frequency of 600 cycles, I found that 27 transistors with gains varying from 20 to 100 fitted fairly well to this formula:

$$\text{Gain} = 48/\text{ac volts}$$

At higher frequencies, using this method to determine gain becomes a necessity—on my scope, at least. Phase shift between vertical and horizontal amplifiers makes the straight line of Fig. 2 a very narrow ellipse at about 6,000 cycles. At 60 kc the trace is a distorted but definite ellipse, and at 600 kc, nearly a circle. Clearly, the slope of the trace can no longer be used to measure gain.

With the ac voltage method, gain checks are as easy at higher frequencies as at audio. Simply increase the voltage from the signal generator until the trace —whatever its shape—reaches a maximum height, beyond which it only broadens. That is the ac voltage required to "swing" the transistor along its operating range, shown in Fig. 2. Read the meter and substitute the reading for "ac volts" in the formula above.

This technique is especially useful for matching transistors to be used for medium-frequency work. Low-frequency gains give no hint of gain at higher frequencies. Two transistors from the same radio both measured 67 at low frequency, but at 510 kc one read 120, the other 24. The high-gain transistor was in the rf, the other in the audio circuit.

I recently built a transistor frequency standard, and I found that I could improve performance noticeably by rearranging transistors according to the results from the gain check just described. Performance variations between transistors of the same type aren't restricted only to low-cost types. At 510 kc, gains for three $3 transistors varied from 40 to 70. In instruments where transistor gain affects results, a little preliminary checking at the actual operating frequency can save time and trouble.

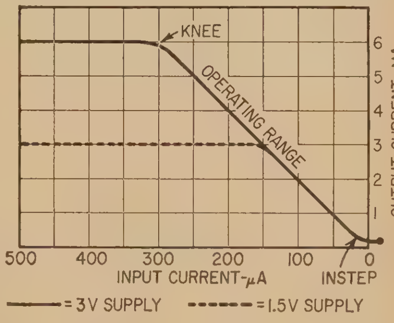


Fig. 2—Transistor operating range chart.

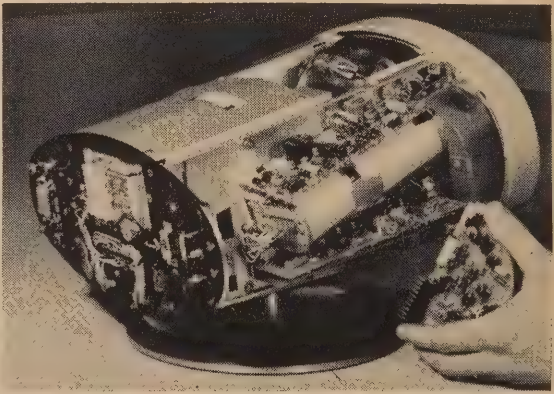
Though at high frequencies the scope traces don't give a direct indication of gain, the trace of a good, high-gain rf transistor is quite distinct from lower-gain, lower-frequency transistors.

My compliments to Mr. Smith for the simple way in which he presented his idea. END

Radio-Electronics GOES TO THE WORLD'S FAIR

RCA
OFFICIAL COLOR TV
COMMUNICATIONS CENTER

Color TV sets all over fairgrounds are programmed from this studio and control room at RCA pavilion (upper right). Public is invited to watch live shows telecast from four color cameras, four all-transistor videotape recorders and coaxial-cable rf distribution system. Pavilion also features see-yourself-on-color-TV, with a taped delay. You see yourself twice: once live and again 15 seconds later, exactly the same!

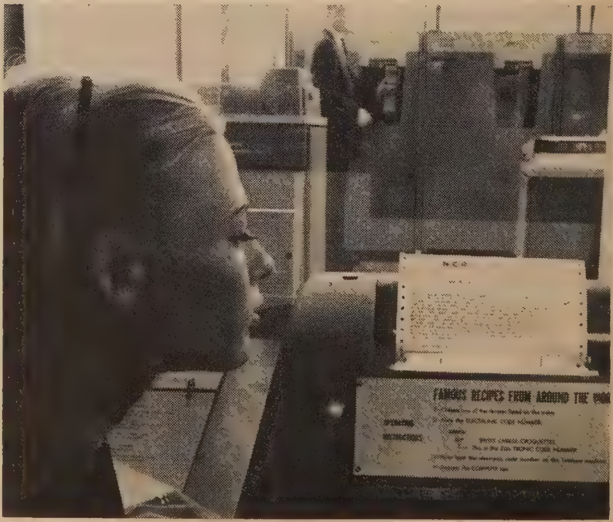


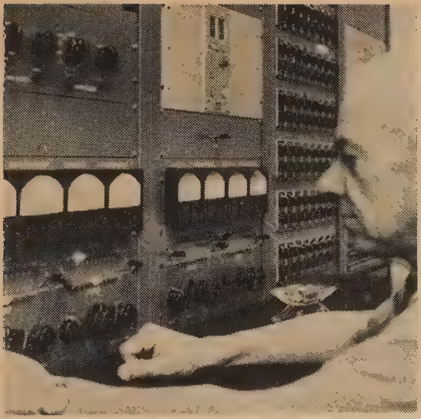
What's inside Bell Telephone's Picturephone. Six booths at American Tel & Tel pavilion are equipped with Picturephones so visitors can talk to—and see—each other. (See July RADIO-ELECTRONICS, page 6.)

Whole family of Walt Disney "audioanimatronic" figures like "Granny" here are "cast" of 20-minute show at General Electric pavilion. Figures are driven by electropneumatic machinery, controlled by 32-track magnetic tape. Three closed-circuit TV monitors in background can be switched among 21 cameras around pavilion. In case of trouble, help can come fast. Charts and counters at right keep track of attendance.

►

Teleprinter has just divulged recipe for Swiss-cheese croquettes. Unit at National Cash Register pavilion is linked to computer (background). Other installations at NCR make magic squares based on visitors' favorite numbers, answer scientific questions, give information on vacation sites.





Elaborate sound system pipes "walking music", announcements and coded emergency signals to 470 RCA-designed speakers concealed in lamp posts all over grounds. System is controlled from panel which houses line amplifiers that drive 88 75-watt power amplifiers in 16 locations around fairgrounds. Level to each sector of fair is individually controlled, so each gets optimum sound. Music is pretaped on 14-inch reels; cartridge tapes carry special announcements. Engineer Ed Mackey, above, is one of 12 who operate system.

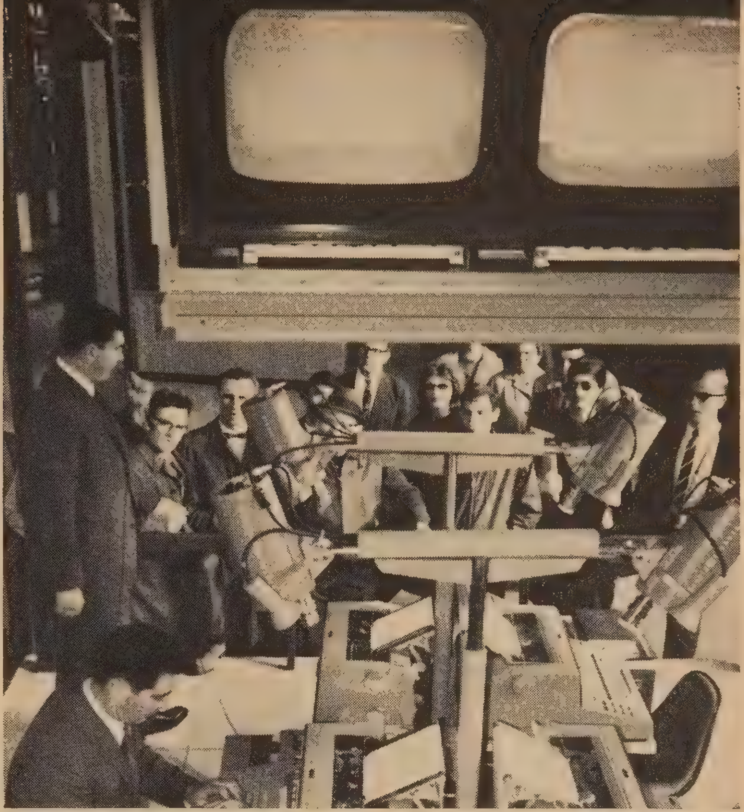
Sound System Sports Unusual Failure Monitor

The intricate sound system at the New York World's Fair would be a nightmare to operate and maintain if it weren't for an ingenious system of automatic checking and reporting designed to uncover failures and potential breakdowns immediately and pinpoint them exactly.

At each power amplifier location, which is remote from the main control room and may contain half a dozen amplifiers, there is a test chassis that includes an audio oscillator and timing mechanism. Once each hour, the program is cut off automatically at that bank of amplifiers only, and a short high-frequency audio pulse fed in. The input pulse is compared with the output pulse; if everything is shipshape, fine. If not, a relay flashes a lamp on a panel back at the master control room. The operator on duty, seeing the light, can tell instantly where the trouble is and send a man out to investigate.

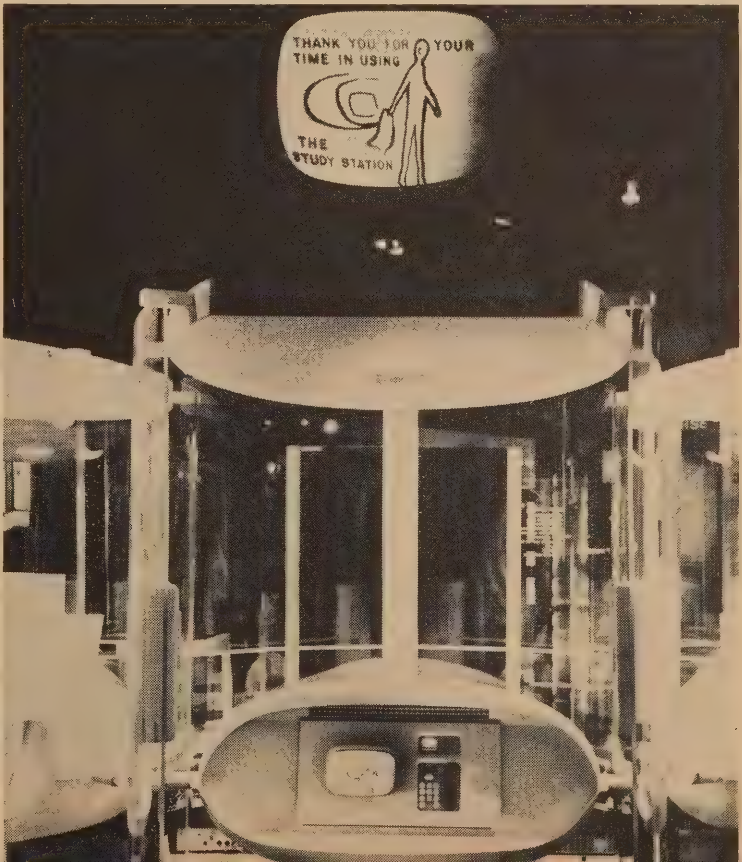
The amplifier banks also incorporate thermostats that monitor the temperature of each unit. If an amplifier overheats (suggesting a short in a speaker line, a gassy tube, etc.) or goes cold (because of a burned-out tube or blown fuse), again a light flashes in the control room to pinpoint the trouble.

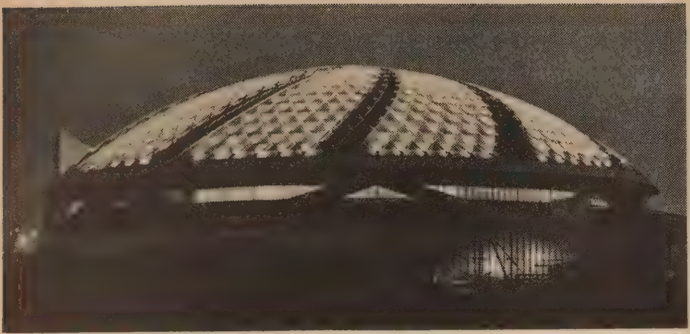
Jacks in patch panels at the control room make it quick and easy to substitute a defective unit without physically removing and replacing it, or to use some other-than-normal program routing, perhaps to bypass a dead amplifier. Flexibility and adaptability are key ideas behind the design of this amazing system.



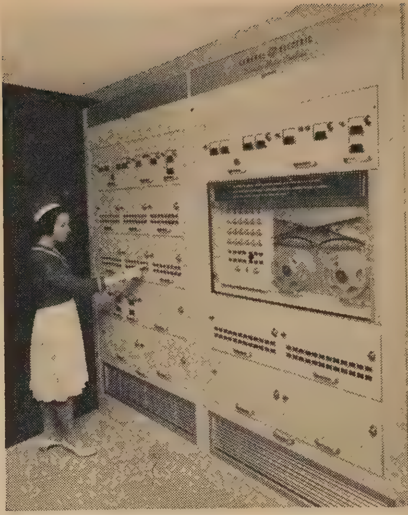
Fairgoers watch typist copy Russian text into teleprinter which relays it 90 miles to IBM language-translating computer in Kingston, N.Y. English rendering, back in a second or two, is printed out on another machine. Overhead TV screens display Russian and English texts side by side.

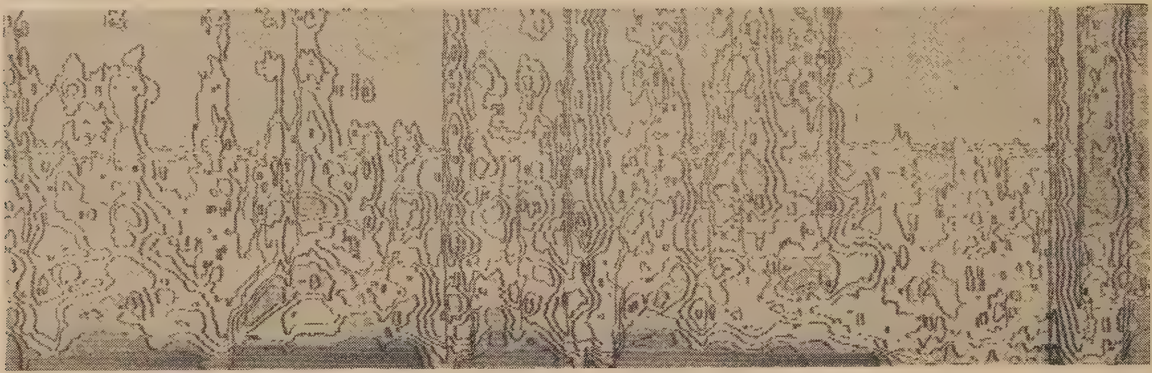
Audiovisual Learning Center Station No. 2 in U. S. Pavilion is one of three designed to display potentialities of electronic teaching aids. Visitors can participate in learning programs. B&K 1076 Flying-Spot Scanner televises fixed slides for display on screens like those in photo.

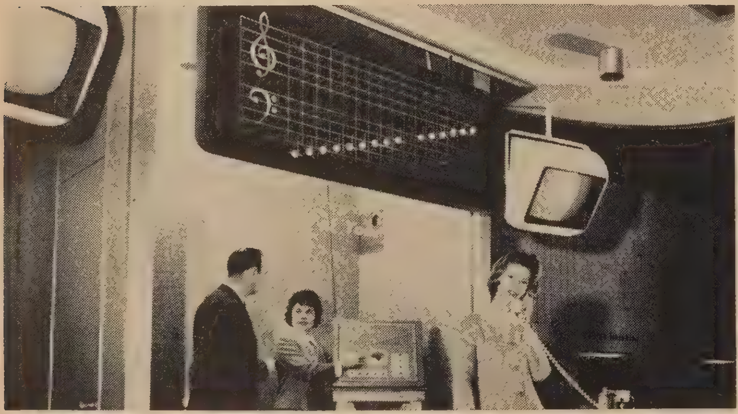




G-E hostess points out control panel of "Directo-Matic" apparatus (right) used to control spectacular night-time dome lighting at G-E pavilion (above). Crisscross roof-supporting grid of steel tubes is flooded with 2,112 colored lights dimmed and turned on and off by silicon controlled rectifiers. Reels at right carry punched paper tape that controls lights.







Vocoder (in booth in back), valuable speech research tool, literally takes sounds apart and reassembles them. It can alter pitch without affecting speed (unlike a tape recorder). Also at Bell (AT&T) pavilion was "speechprint" apparatus (counter in front). It makes distinctive patterns on paper of people's voices and helps researchers break speech sounds down into essential elements. Pattern reproduced above is R-E's associate editor's voice as he announces, "I'm from Radio-Electronics."

Another popular computer stunt at IBM pavilion is "character recognition." Visitor writes date of birth, all in figures, on card. Card is fed into machine, numbers are scanned optically and sent to computer, which extracts **New York Times** lead headline for that date. Headline is displayed on screen overhead, and visitor gets printed-out souvenir. System accepts many writing styles, though wild flourishes are rejected. Direct written-number recognition could speed data processing tremendously.

BOLSHEVIST REVOLT STARTS IN
POLISH OFFICERS PARTICIPATE

Squashed picture? Pointed heads? Screen look like somebody's changing slides? Find out why, and how to fix it

By JACK DARR
SERVICE EDITOR

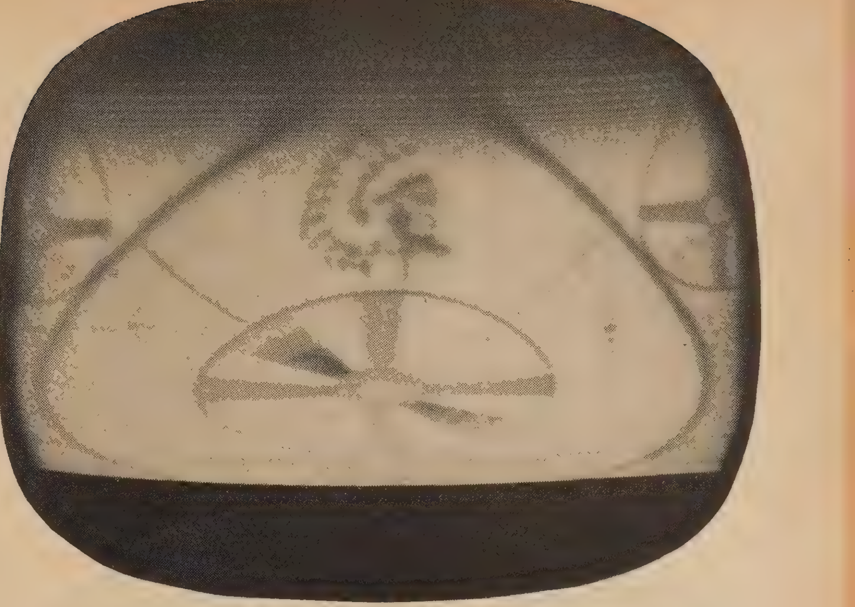


Fig. 2—Open vertical output cathode bypass compresses bottom of picture.

Vertical Sweep and Sync Troubles

VERTICAL TROUBLES WILL ALWAYS CAUSE immediate complaints from customers. They're so obvious! Rolling, flipping, lack of height and poor vertical linearity show up so badly that even the most "unskilled" customer can see them. Poor vertical hold is very annoying, since the picture always rolls just at the most interesting part of the show. Let's look at some of the causes and cures for this.

A twist of the vertical hold control will tell you how the circuit is working. Normal: the picture should roll smoothly down, and the vertical blanking bar should stay the same width all the way (linearity good). Just before the bar gets to the bottom, it should suddenly snap out of sight. That means good sync. Turning the control the other way, the picture should hold until you reach the critical point, then roll upward (flip) very rapidly.

Rolling the bar halfway down the screen, then back up, the picture should show a very definite "snap" when it locks in. If it doesn't or if you can roll a picture *upward* slowly, there's trouble. The hold control should stop the picture somewhere near the center of its range. If it stops only when the control is all the way to one end, trouble again. Maybe not now, but soon. Fix it now and avoid a callback!

Now let's take a typical vertical oscillator–output stage apart and see what makes it tick. Fig. 1 shows a circuit used in a lot of sets lately. The tube is a twin-triode, in this case a 6CM7, but it could be any one of several like it. The triodes are different. The left, called the "oscillator" from now on, is a *voltage* amplifier, and the right ("output") is a *power* amplifier. This is a plate-coupled multivibrator circuit. Parts values shown here are taken from an actual circuit. You will find some other values in other sets, but the *function* of each will be the same.

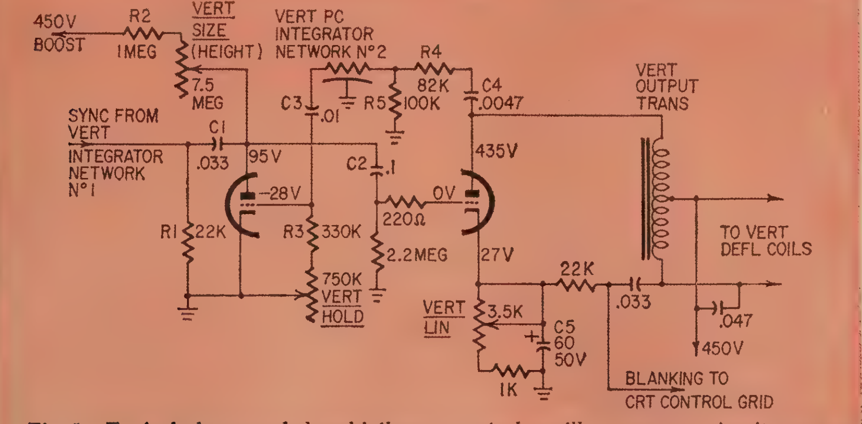


Fig. 1—Typical plate-coupled multivibrator vertical oscillator–output circuit.

This circuit works like all multivibrators. Think of it as a standard resistance-coupled amplifier circuit with the output fed back to the input, and it may be clearer; the plate of each tube is coupled to the grid of the other. One difference: because of the high signal level at the plate of the output half, the pulses are shaped and attenuated through the R-C network C4–R4–R5–C3 before being fed to the grid of the "oscillator". High resistance values are found, because most of these stages are fed from the boost.

Paper capacitors cause most of the trouble. Grid bias is critical, and most capacitors are connected between plate and grid in some way. Even a small leakage allows the plate voltage to leak through to the grid, and away goes your bias. Let's see what that can cause.

C1 couples the sync into the plate circuit of the oscillator. The sync here should be about 50–60 volts peak to peak, negative-going. This plate circuit is very high-impedance: look at the values of the resistors—7.5 megs, etc. So, if C1 leaks, it reduces the plate load resistance—note the 22,000-ohm resistor R1 to ground on the input side (part of the vertical integrator network). Symptom: poor sync action, no snap in the picture, and sometimes poor linearity.

C3 is part of the R-C network which feeds back pulses from the output plate to the input grid; this maintains the oscillator action. The pulses are reduced in amplitude, and shaped for the best linearity. Since this circuit feeds directly into the "frequency-determining" circuit, with the vertical hold control, you can see that any capacitor leakage here is going to foul up the hold action. The actual control of vertical frequency is done by the grid bias developed on the oscillator grid across the vertical hold control (up to 750,000 ohms) and its series resistor R3, 330,000 ohms. If we let any positive voltage leak into this circuit from the other plate, troubles!

Symptoms: very poor hold action—control has to be jammed up against one end. If one of the capacitors (C3 or C4) is shorted, you'll probably not be able to get a picture to stand still at all. Most common symptom: "two pictures" on the screen, almost locked in. The oscillator is running at half normal speed.

C2 is the "main" coupling capacitor, between "oscillator" and "output" sections. If it leaks, it upsets the vertical linearity badly.

Last of the capacitors is the big electrolytic in the cathode circuit of the "output" stage, C5. If this opens or develops a high power factor, we get degeneration in the cathode and loss of gain. The picture will look like Fig. 2. Note the key symptom: compression at the *bottom* of the picture. Other defects—weak tubes, etc.—cause compression at the *top*. Simple test: just bridge a good electrolytic across C5, of any size from 50 to 100 μf. If the picture comes back up to normal, C5 is bad; replace it. Incidentally, if you get "peculiar symptoms", especially as to the linearity, try disconnecting this capacitor if it's a part of a multiple electrolytic, and hooking in a separate unit. Some very unusual symptoms can come from leakage between elements of a multiple capacitor!

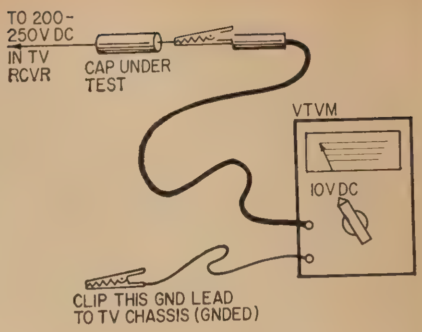

TO 200-250V DC IN TV RCVR
CAP UNDER TEST
VTVM
10V DC
CLIP THIS GND LEAD TO TV CHASSIS (GNDED)

Fig. 3—Quick leakage test for paper capacitors.

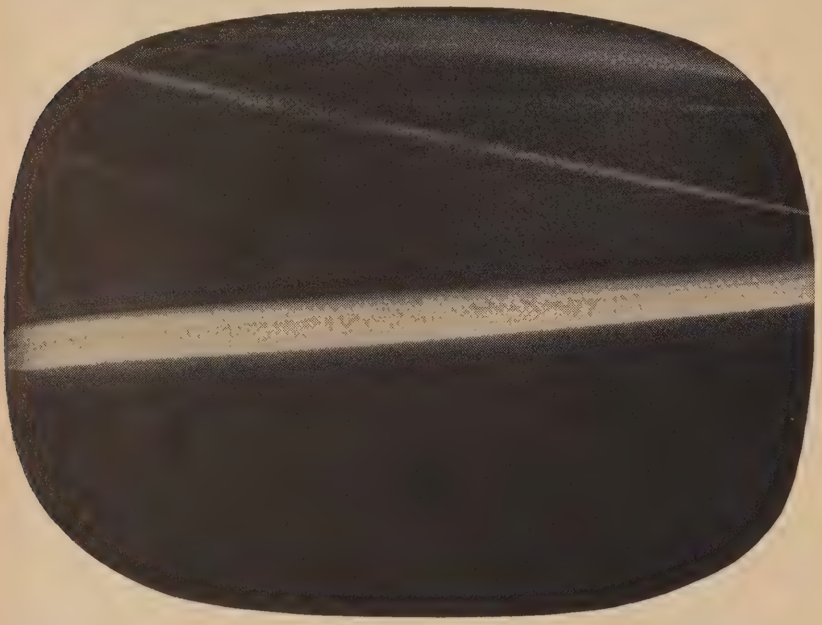
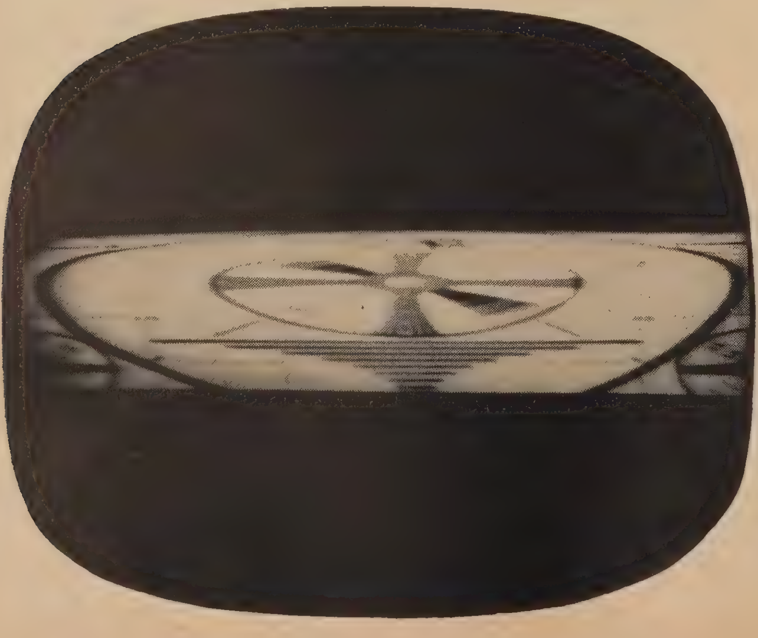


Fig. 4—Extreme mismatch in vertical output transformer!

Fig. 5—If this is all you can get after replacing an autotransformer with a two-winding type, reverse one of the windings.



Testing paper capacitors for leakage

It takes only a *very* small leakage in any of the paper capacitors to upset things, so check carefully. If you have a tester that reads insulation resistance up to hundreds of megohms, use it and throw out any capacitor that won't give at least a ¾-scale reading. For replacements, use only 600-volt capacitors of the best quality you can get, and for goodness' sake *test them before you put them in!* Many a "dog" has been born by using new capacitors with more leakage than the ones you just took out!

Here's a quick check, just as accurate (Fig. 3). Set your vtvm on a low dc-volts scale; clip the ground to the TV chassis. Take the capacitor completely out of the circuit, and hook the dc volts probe to one end. Touch the other to a source of 250–300 volts dc in the TV set. If you get any reading at all, the capacitor is leaky.

In some sets, you can get the same check by pulling the tube, leaving the capacitor connected to the plate and taking the voltage reading at the grid end, unless the grid resistors are too small (less than 2 megohms total). By turning the set on, you apply positive voltage to the plate end of the capacitor. You can do this, even in series-string sets, because the semiconductor rectifier

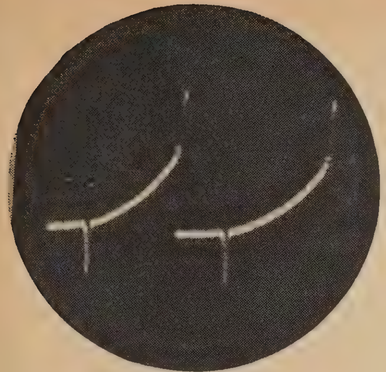
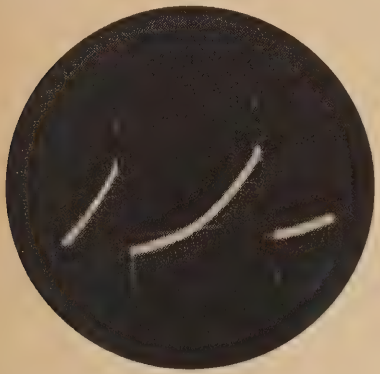


Fig. 6—Rolling picture halfway down puts sync pulses along trace at oscillator input.

Fig. 7—Same point as Fig. 6, but picture locked in.



delivers B-plus voltage regardless of continuity in the heater circuit.

Resistors are also good possibilities for trouble. Measure each one carefully, according to its color code. Also, if the complaint is "slow drifting and loss of sync," heat each one with a soldering iron to see if it changes value. Most commonly found off are the resistor in series with the vertical hold control, and others that affect the frequency directly.

The vertical output transformer

A lot of these are replaced unnecessarily. They don't give too much trouble, really. Replace one only after checking out *all* capacitors and resistors. You can hang a new transformer in the circuit for a test without dismounting the old one. A couple of common troubles: wrong impedance—Fig. 4 shows a *severe* mismatch. Most vot's are autotransformers now. They can be replaced by a separate-winding transformer of the correct impedance, by connecting the end of the primary to the end of the secondary. Watch your phasing! If you make a replacement and find something like Fig. 5, reverse *one* of the windings.

Sync

There's only one thing you can check sync with, and that's a scope with a low-capacitance probe. Connect it to the sync input, plate or grid, and turn the vertical hold control until the blanking bar rolls about halfway down the screen. You should see a pattern somewhat like Fig. 6. That, by the way, was taken from a different oscillator circuit and shows positive-going sync. In the multivibrator type, the sync is negative-going, but what we're after is "Is it there, and if so, is it high enough?" In most cases, the value will be given on the schematic.

Grid sync is usually around 7–10 volts p–p, while plate sync will run from 40 to 60 volts p–p.

A "locked" picture looks like Fig. 7. This is at an oscillator grid, and the apparent nonlinearity is normal; it's corrected in the output stage. These waveforms, too, will be shown on the diagram. However, the picture itself is by far the easiest thing to trace nonlinearity with, because of conditions in the set, and possible differences between your scope and the one they took the waveform pictures with. Use a test pattern, or some round figure in a commercial, like the CBS "eye". That's a very good linearity checker.

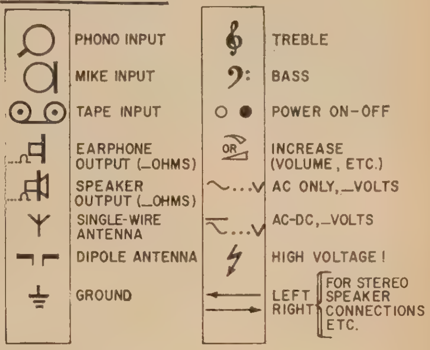
In a very few sets, you can improve vertical sync by changing values in the vertical integrator. A classic example of this is the old G-E "M" series portable. If you reduce the 100,000-ohm series resistor to about 56,000 ohms, and increase the series capacitor to about .02 μf, this brings up the vertical sync amplitude and helps out amazingly. However, do that sort of thing only as a last resort. If you do it, be sure to check not only for sync amplitude but for possible bad effects on linearity, etc.

Open vertical height and linearity controls can often be "repaired" by simply moving a lead to the other end of the resistance element. These controls are usually connected as rheostats, with only the slider and one end used. If the element opens up at one end, move the wire to the other, and you won't have to replace the control. Makes it work backward, of course, but nobody's supposed to be fooling with it anyhow but us! Intermittent vertical sweep trouble in lots of cases comes from a "dirty spot" on either the linearity or the height control. This is caused by the control slider sitting in the same place for some time. You can usually get around this either by cleaning the control or by moving the slider to another place, compensating by resetting the other control very slightly. Sometimes, if the burnt spot is too big, you'll have to move the lead to the other end of the control to get a fresh spot for the slider to sit on. END

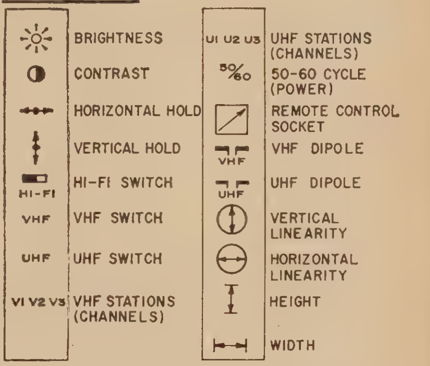
Terminal and Control Markings on Foreign Radios

With the ever-increasing number of foreign-made radios and phonographs being imported into the USA, the chance that a technician will run into one goes up.

RADIO-PHONO


PHONO INPUT
MIKE INPUT
TAPE INPUT
EARPHONE OUTPUT (_OHMS)
SPEAKER OUTPUT (_OHMS)
SINGLE-WIRE ANTENNA
DIPOLE ANTENNA
GROUND
TREBLE
BASS
POWER ON-OFF
OR
INCREASE (VOLUME, ETC.)
AC ONLY,_VOLTS
AC-DC,_VOLTS
HIGH VOLTAGE!
LEFT
RIGHT
FOR STEREO SPEAKER CONNECTIONS ETC.

TELEVISION

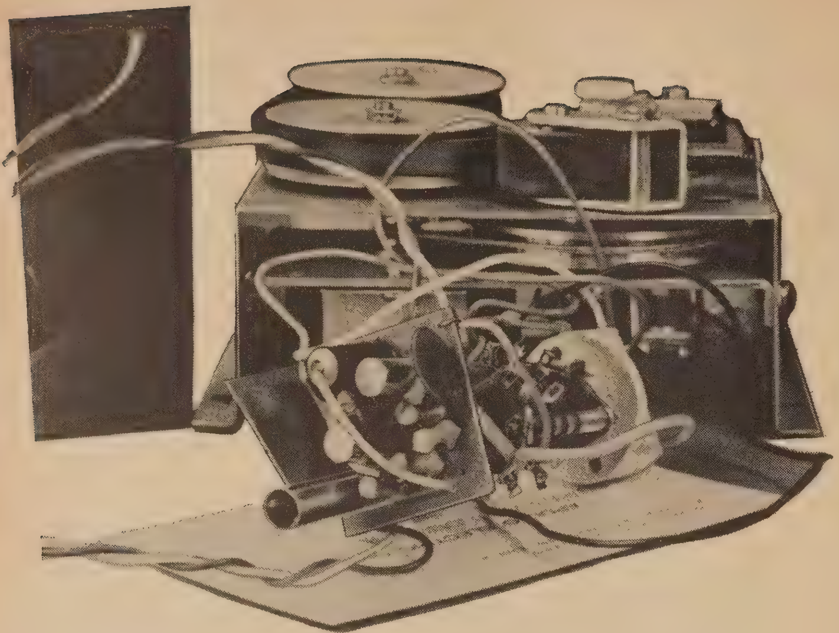

BRIGHTNESS
CONTRAST
HORIZONTAL HOLD
VERTICAL HOLD
HI-FI
HI-FI SWITCH
VHF
VHF SWITCH
UHF
UHF SWITCH
V1 V2 V3
VHF STATIONS (CHANNELS)
U1 U2 U3
UHF STATIONS (CHANNELS)
50/60
50-60 CYCLE (POWER)
REMOTE CONTROL SOCKET
VHF
VHF DIPOLE
UHF
UHF DIPOLE
VERTICAL LINEARITY
HORIZONTAL LINEARITY
HEIGHT
WIDTH

The sets are "internationalized" to some extent by their use of symbols rather than words to mark the various controls and functions. The symbols have been pretty well standardized throughout Europe by the efforts of the IEC and the Philips Co., and most of them are easily recognizable. Some, however, are a little more obscure; so, as a guide to the man who encounters a Grundig or Geloso or Tandberg or Telefunken, here are the symbols and their meanings.—*Peter E. Sutheim*

Rotator Repair, Part II

Unavoidable Postponement

The first installment of "Rotator Repair," by Homer L. Davidson, appeared in last month's issue. Because of additional information on some of the material in the second portion, we are re-editing it, and it has become inexpedient to include it in this issue. It will appear in October.



Tiny amplifier, after circuit in Fig. 1, is smaller than switch it's mounted on. It was designed for tape recorder to be used in talking doll.

Push-Pull Output From One Transistor

Single output transistor drives two speakers in push-pull in these direct-coupled amplifiers

By LEONARD E. GEISLER

THIS ARTICLE MIGHT HAVE BEEN TITLED "How to Get Something for Nothing—Almost." Here is a deliciously simple amplifier with a push-pull output taken from a single transistor, connected much like the familiar split-load phase inverter. Fig. 1 shows a two-transistor circuit designed around the principle. Direct coupling saves many parts and assures excellent low-frequency response. With the details given here, you can apply the same techniques to other transistors, for other applications.

In Fig. 1, Q1 is both an ac driver and part of the dc bias system, since the amplifier is direct-coupled. Try to get as nearly as possible the voltages shown on the schematic. Other transistors may need some value juggling. In any case, try to get equal dc drops across the output transistor's two loads (emitter and collector). Q2, the output transistor, should be biased (by varying R2) so that it works near the center of its class-A load-line, for minimum distortion.

C2 in Fig. 1 allows you to tailor the amplifier's response to fit a particular application. The larger C2, the higher the gain of the whole amplifier. With C2 omitted altogether, there is heavy negative feedback around the amplifier and its response is pretty flat from dc (if C1 is jumped) to over 30 kc. But the gain is only 35 db. The value of C2 shown in Fig. 1 gives fairly flat response above 1 kc, puts 500 cycles about 2 db down and rolls off rapidly below that. At 100 cycles there is very little gain at all. This was done deliberately in the original to compensate for an unwanted resonance in the little speakers it was to be used with.

Power output, using 2N215's as shown, is a conservative 35 mw. On a scope, clipping was visible at 50 mw, though not really audible. At 60 mw it was audible, but could be eliminated by disconnecting C2. Then, naturally, the amplifier needed a higher driving voltage.

More muscle

If you want high power, try transistors in TO-3 (diamond-shaped) cases,

R1, R3—4,700 ohms
R2—6,800 ohms
C1—0.1 µf
C2—.05 µf (see text)
Q1, Q2—2N215
2 8-ohm speakers (see text)

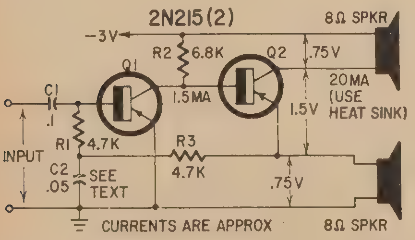


Fig. 1—Low-power version. You can use a single speaker with a double voice coil.

R1—68,000 ohms
R2—8,200 ohms (see text)
R3—see text
C—0.5 µf
Q1, Q2—2N215
Q3—2N554
2 4-ohm speakers (see text)

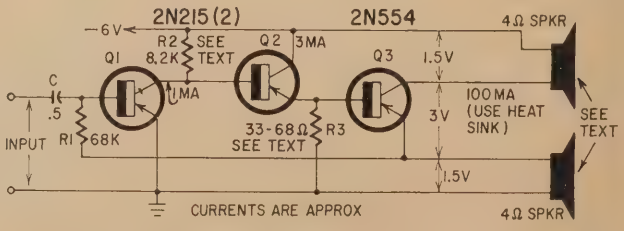
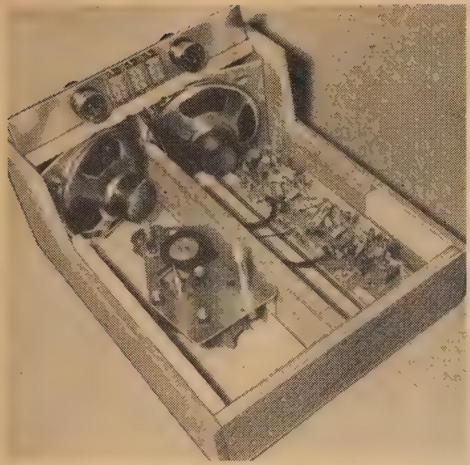
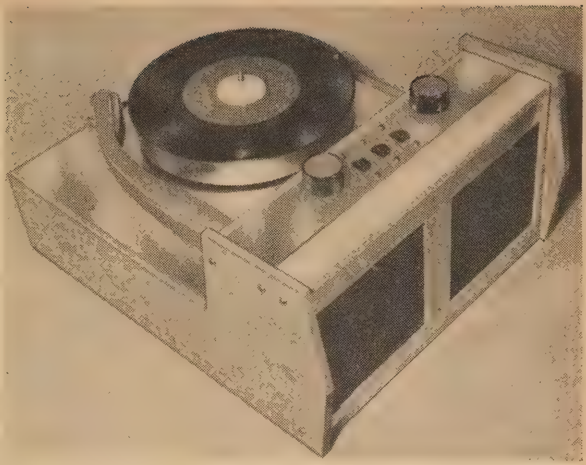


Fig. 2—Higher-powered circuit. Feedback through R1 gives excellent performance.



Two views of a miniature stereo phonograph using two amplifiers like ones described.



with heat sinks. Fig. 2 shows the circuit adapted for a 2N554 to yield about 1 watt output. R3 should be kept between 33 and 68 ohms. Again, vary R2 as necessary to give Q3 the correct static dc bias (adjust for I_c of about 100 ma).

Both circuits are stable between −10°C and 55°C. Beyond these limits, R1 in both circuits should be reduced 20 to 40%.

Input impedance is several thousand ohms in both circuits, so they can be driven easily by other transistor circuits or by high-impedance devices through step-down transformers.

The output load can be two separate speakers or transformer windings, or combined into a single speaker with a bifilar-wound double voice coil. With proper attention to phasing and dc polarity, you can prevent mechanical biasing on the speaker (off-centering due to dc component of current through voice coil). If the two windings are in phase, the output stage will oscillate in the grounded-base mode.

If you're interested in fuller (mathematical) analysis of this idea, turn to "Splitting the Load," by O. Greiter, *Wireless World*, February 1962, page 71. (The article came to my attention only after the lab work on this amplifier was done.)

Applications

The photographs above show a tiny stereo phonograph using amplifiers like the ones described here. The head shows an early version in the lab. It's lying on an ordinary 2 x 3½-inch calling card. Above it is a miniature "disposable" tape recorder deck intended for a talking doll. That's standard ¼-inch tape, which should show you how small this amplifier can be! Actually, it was developed as a "gutless wonder" suitable for use in a disposable tape recorder. Think a little, and you'll surely be able to dream up uses for this simple, reliable circuit. END

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dynamic limiting with a photoresistor

ONE OF THE MOST MADDENING THINGS a PA technician has to contend with is the vast and rapid change in volume as the speaker, previously talking in a normal voice at about 2 feet from the microphone, leans into the mike and raises his voice to emphasize a point. The technician must rush to turn down the volume—and, shortly after, to turn it up again.

Dynamic limiting is the answer and one interesting method, introduced in some recent Philips amplifiers, is shown here. The principle follows the diagram (Fig. 1). A photoresistor is used as the control. It forms one part of a voltage divider. The other parts consist of isolating resistors R3 and R4.

A portion of the output signal is taken from winding L on the output transformer, fed through R6 and R7 to a small lamp focused on the photoresistor. When the lamp lights brightly with a strong output signal, the photoresistor's resistance drops, reducing the signal input to the amplifier. Because of the delay in the lamp filament lighting, sudden or short-duration voltage pulses have no effect. To limit these pulses, a neon lamp is also included. It reacts more rapidly, but requires a greater voltage before it lights.

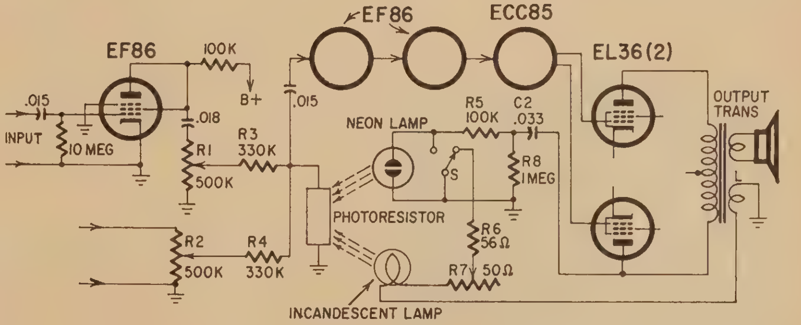


Fig.1

(*An expander-compressor using neon lamps and a photoresistive cell, the Fairchild* Compander, *is made in this country* (*RADIO-ELECTRONICS, Jan. 1962, p. 39.*

The curve (Fig. 2) shows the effect of the circuit. You can see that with this type of regulation, up to about 35-db greater variation in the input signal is possible before running into the severe distortion that accompanies an overloaded amplifier. Possibility of acoustic feedback is also reduced.—*Radio og Fjernsyn, March, 1962*

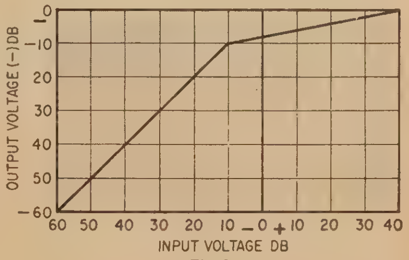


Fig.2

Peewee Learns Sound Reasoning

YOU WON'T NECESSARILY CURE A BAD CONNECTION BY RESOLDERING EVERYTHING IN SIGHT

By MIKE WAYNE

Peewee was muttering to himself.

"What's the matter?" I asked.

"It's the dern sound on this RCA."

"What's the matter with it?"

"If I knew that, I'd have it fixed," he retorted.

"OK," I said," I'll rephrase the question. How does it act?"

"Acts terrible," he replied, now being deliberately obnoxious but, after a pause for effect, he continued. "It plays OK for 30 minutes or so, then the audio drops to nothing."

"What have you checked?" I asked.

"Just about everything."

"Then you should have it narrowed down pretty close—just check the few things you haven't checked and you got it made."

"Aw-w, you know what I mean," grumbled Peewee. "How can you check an intermittent? Every time I start to put a test probe onto something it starts playing again."

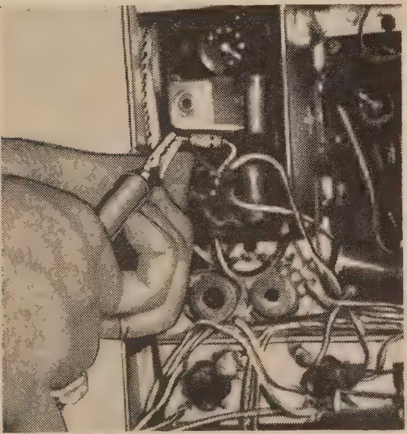
"Have you narrowed down the trouble at all?" I wanted to know.

"Well," said Peewee, "at least I know it's somewhere before the volume control. I put our audio signal tracer there and left it. When the sound went off, it went off on the signal tracer, too."

"Good, at least we know the trouble isn't in the audio amplifier or output stage, so it must be somewhere between the video detector and the volume control—that is, if the picture isn't going off too."

"Picture stays OK," he assured me. Then he asked, "Do you know some easy way of localizing that part of the circuit?"

"Oh, there are probably lotsa ways of doing it but since you want an easy way, why not use the vtvm?"



Clipping the vtvm onto the limiter grid resistor.

"Look here at the schematic," I instructed. "See the 47,000-ohm resistor in the grid circuit of the 5U8?"

"You mean R101?"

"I mean R101. That's the limiter grid resistor."

"Even I know that, but so what?"

"So what happens when a signal is coming into this stage?"

"You get a negative voltage across the resistor, I guess."

"Right," I agreed. "And that voltage is proportional to what?"

"To the signal strength, I suppose."

"Bravo," I said. "Does that suggest a way to use the vtvm?"

Peewee thought a moment and then started radiating effervescence like an Alka-Seltzer dropped in water. "If the signal is dropping out between the video amplifier and the 5U8 grid," he reasoned, "it'll show up as a drop in voltage across the limiter grid resistor."

"Congratulations! Now put the vtvm on there and wait. When the sound goes down again, you'll know which way to look for the trouble. Right?"

"Right."

About 15 minutes later the sound dropped down again but the voltage reading didn't waver.

It's OK up to the limiter

"What does that tell you?" I asked.

"Means everything's hunkydory up to the limiter," he replied. "And that just leaves the limiter tube and the detector transformer that could be bad."

"Whoa up a minute," I cautioned. "Not so fast. It also leaves the wiring, a half-dozen resistors and capacitors, not to mention the detector tube and its circuits."

"Y' think it might be the printed-circuit board?" he asked.

"Could be, and it looks like someone before us had the same idea, judging by all the soldering that's been done."

"I guess you could say that was a pretty popular board," said Peewee.

"How's that?"

"Looks like it was in its second printing."

"I see your point. But let's get on with the problem and see if we can't localize it to either the limiter or detector stage."

"Why not put the vtvm across the ratio detector capacitor, C108?" he wondered.

"Now you're thinkin'. But this circuit is a little unusual. One side of the capacitor isn't grounded. Let's just measure from one side of it to ground."

"Will that work OK?"

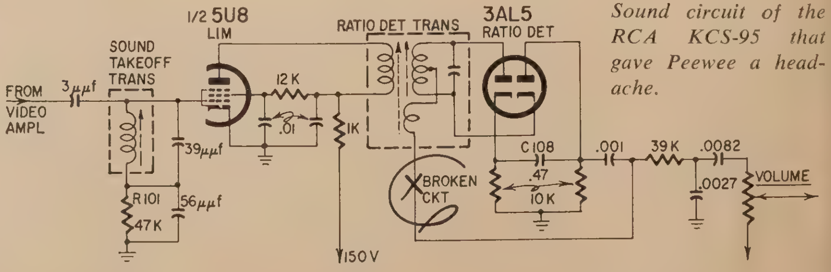
"Sure, it'll be simply measuring the voltage drop across half the detector load resistance."

"Why doesn't this circuit have a grounded capacitor?" he wanted to know.

"Makes it simpler to adjust," I answered. "All you have to do is connect a vtvm between the junction of the 39,000-ohm resistor and the .0082-μf capacitor and ground, and then adjust the detector transformer slug for zero voltage."

"On a station signal?" he asked.

"That's the best way. But let's get



Sound circuit of the RCA KCS-95 that gave Peewee a headache.

back to the trouble. Connect the vtvm through this hole in the shield to one side of the 0.47-μf capacitor (C108)."

Peewee did as he was told but, as soon as he moved the probe, the sound returned full volume. "Wouldn't you know it?" he said disgustedly.

"Don't worry about it. We have to have a reference anyhow."

He clipped on the test lead and we noted the reading. This time, as if finally giving up its capricious habits, the sound dropped out in a couple of minutes.

"Well, I'll be derned," said Peewee. "Come here."

I walked over and glanced at the meter at which he stared in disbelief.

"Didn't budge, did it?" I smiled knowingly, but I was almost as surprised as he.

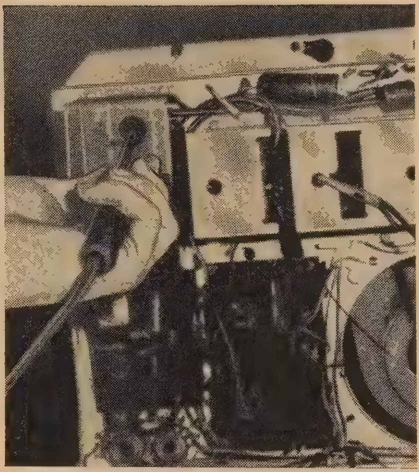
We both looked at the circuit again.

"You sure the sound goes down when you hook the tracer to the top of the volume control?"

"Dern sure," he asserted.

"Then that doesn't leave much, does it?"

"Just a capacitor or three and a resistor. I've already checked on the other side of the .0082 capacitor and there was no sound there either. Then I moved back to the other side of the 39,000-ohm resistor and it wasn't there either."



Connecting the vtvm to one side of ratio-detector capacitor C108, through the hole provided in the shield.

"Then that just leaves a broken printed circuit or an open in the tertiary winding inside the detector transformer. Watch the terminals while I wiggle the transformer."

I moved the transformer gently from side to side. The sound came back on once or twice in random fashion. Then Peewee yelled, "I see it! I see it! The terminal on the transformer is loose from the board."

Peewee resoldered the connection while I philosophized, "Try as you will to resolder every connection on a printed board, you'll just about always miss the one bad place—at least that's been my experience. Whoever worked on this set before had the same trouble. All his soldering probably just quieted things down 'til he got the set back to the customer's home. When it started to act up again the same way, the customer was disgusted and brought the set to us. Our friend, whoever he was, lost a customer because he didn't have a way to localize the trouble."

"My turn to take to the soap box," said Peewee. "Ever notice how if connections get close together when they're not supposed to, they'll short sure as shootin'—but when they're close together and *supposed* to be together, they'll open every time—ever think about that?"

"How's that again?"

"Oh, never mind," he said, "who listens to me anyhow?"

I thought he seemed just a little peeved that I had apparently missed this bit of world-shaking wisdom. END

What's Your Eq?

Conducted by
E. D. CLARK

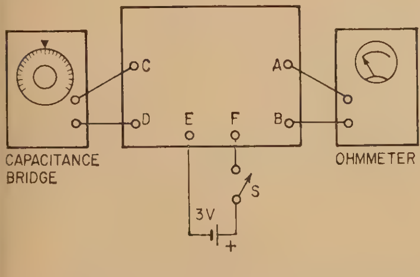
Two puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.

Answers to this month's puzzles are on page 105.

What's in the Box?

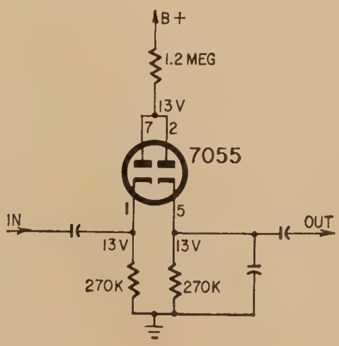
I have presented this problem to many technicians and, though the answer is simple, they have failed to find it. This, I think, is due to the fact that they tend to complicate a simple problem.



Before the switch is closed, the capacitance bridge reads 5 pf, and the ohmmeter reads 1 ohm. After the switch is closed, the bridge reads 50 pf, and the ohmmeter 5 ohms. Reverse battery polarity, and readings revert to original. Voltage check at terminals A–B shows no voltage present. What's in the black box?—*E.J. Cunningham*

Reverse Polarity

In trouble-shooting a 40-mc, 100-watt mobile transmitter, all electrode voltages as measured with a standard 20,000 ohms per volt vom agree with the manufacturer's schematic—except that the voltage at the plates of the 7055 (12AL5) audio limiter is a *negative* 13 volts! A new-tested tube results in the same reading. What is wrong? Hint: An 11-meg vtvm reads a positive 13 volts, but when both meters are connected to the plates, *both* read −13 volts.—*Basil Barbee*



50 Years Ago

In Gernsback Publications

In September, 1914

Electrical Experimenter

How to Use the "Electro" Loose Coupler.
Experimental Electricity Course (Lesson 13), by S. Gernsback & H. Winfield Secor.
Another Improved Buzzer Transmitter, by Frank H. Broome.
Danger Signs for Radio Stations.
A Simple Electroscope.
Aerial Mast Construction, by Charles Fitzgerald.
The Sayville Wireless Station.
A Good Mineral Detector, by Ralph Humphrey.
Automatic Ticker Receiver, by John Hays Hammond.
New Pickard Detector Stand.

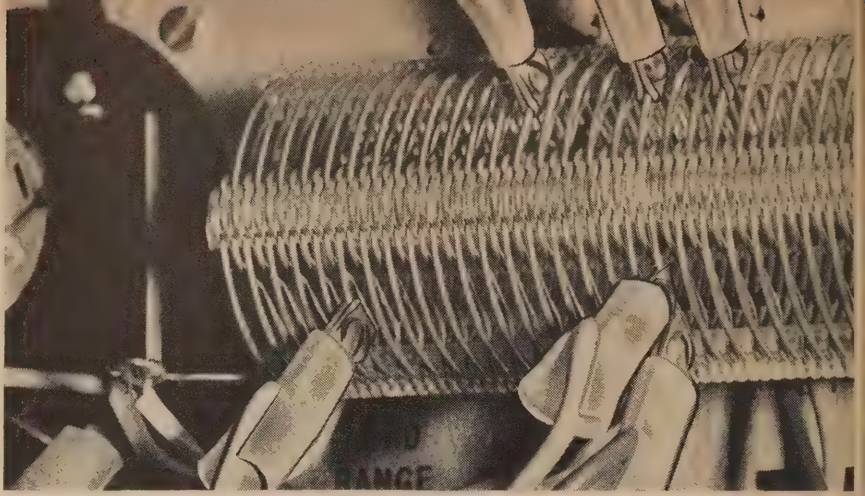


Fig. 2—Typical coil-tapping method used in most marine radiotelephones for tuning antenna, tank and loading coils. This is antenna coil of Bendix SK-242.

Money In Electronics Afloat

What you need to get started in marine electronics service. Tuning and troubleshooting transmitters

By ROBERT C. BEARD

THE ELECTRONICS TECHNICIAN LOCATED near water is a natural in the highly profitable, sometimes exciting, service work aboard boats. Their ever-increasing electronic gear requires competent service and, with few exceptions, the circuits are refreshingly simple compared to even the simplest TV.

In many locations, a scarcity of marine electronics specialists means that, with relatively easy preparation and a little ambition, you can easily earn many times your initial marine service investment during your first season on the boats.

To service ship-to-shore radios, you need a Second-Class radiotelephone operator's license. With a ship radar endorsement for it, you can capitalize on the rapidly expanding radar service field, where rates run as high as $10 an hour. A few weeks of boning up on Elements I, II, III and VIII in a good license manual will cinch the FCC examination.

No license is required to service numerous other marine electronic gadgets: depth sounders, hailers, intercoms, radio direction finders, electronic sirens, power converters and battery charging systems, and automatic pilots. Service data are packed with most new equipment and usually kept handy by the boat owner. Service manuals can be obtained from manufacturers for small fees. Bendix* publishes a perpetual service manual covering all marine electronic items ever made by them. It is kept current by frequent supplements, though the initial and only cost is under $20. Most circuits are simple and basic, however, and you will quickly ignore manuals except for rare dog jobs.

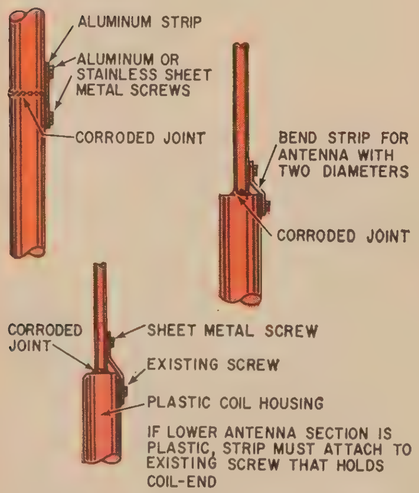

ALUMINUM STRIP
ALUMINUM OR STAINLESS SHEET METAL SCREWS
CORRODED JOINT
BEND STRIP FOR ANTENNA WITH TWO DIAMETERS
CORRODED JOINT
CORRODED JOINT
SHEET METAL SCREW
EXISTING SCREW
PLASTIC COIL HOUSING
IF LOWER ANTENNA SECTION IS PLASTIC, STRIP MUST ATTACH TO EXISTING SCREW THAT HOLDS COIL-END
USE PROPER TAP-DRILL SIZE FOR SCREWS BEING USED. RECOMENDED SCREW SIZE IS Nº10, DRILL SIZE 1/8"

Fig. 1—Corroded antenna section joints that can't be separated for cleaning can be bypassed electrically with strip of metal. Be sure aluminum strip touches only other aluminum parts (except for stainless steel screws); otherwise—corrosion!

My purpose here is to acquaint you with the most common—though not obvious to the novice—troubles in marine service, so you can go right to work on the boats with confidence. Most other problems will be basic circuit analysis.

Making money on the boats means working fast and accurately. This dictates a careful choice of tools and equipment for doing all possible work on the job — without ac power. A transistor power converter (Heath MP-10, or equal) with 8 feet of wire and large battery clips will operate a soldering iron or tube tester from boat batteries.

Your regular service kit should also include open-end and socket wrenches up to ½ inch and a contact burnisher. Carry a spray can of CRC** corrosion proofing (available at most marinas). For space and weight saving, your multimeter should be small and light (Triplett 310 or equivalent). Cover the bottom of your kit with rubber or leather to prevent marring deck surfaces.

A separate "marine service kit" can consist of a batteryless field-strength meter (Heath PM-2 or equivalent), power converter, transistor frequency and modulation meter, supply of marine crystals and pad of transmitter certification slips. These carry well in a canvas beach valise or similar container. A tube tester need not be carried routinely because tube failures are infrequent.

For this reason, you won't need to enlarge tube stock immediately. As you encounter failures, buy an extra of the type required. Common TV and radio tubes are used generally except in transmitters where output stages use 12CU6, 12DQ6, 807, 6883 and similar types. A few of these in stock might prevent a return trip. A small stock of transistors is necessary, and Tung Sol types ET-1 through ET-7 (or equivalent) will serve most purposes. A few extra types such as 2N234A, 2N677B and 2N1136B, will handle modulator and driver failures in most transistor units.

Your stock of marine crystals may be of .01% tolerance since marine tolerances are .02%. The most used frequencies are 2182, 2638 and 2738 kc, plus marine radiotelephone operator frequencies for your area and Coast Guard channels. A list of these is available from the Coast Guard or equipment manufacturers. The above are transmitter frequencies; in most cases, receiver crystals will be those frequencies plus 455 kc (the i.f.), except marine telephones, which send and receive on different frequencies. Receiver crystals for them will be the assigned telephone transmitting frequency plus 455 kc. Petersen† makes reliable, low-priced marine stock crystals. Their type Z-9 holder is the small size with ½-inch pin spacing. Since some radiotelephones use large holders (¾-inch spacing), stock adapters from small to large to eliminate duplicate stock of crystals in large holders. Crystal correlation capacitances vary considerably, but initial stock should be 20–25 pf, which will put most rigs within tolerance. Frequency checks on various transmitters will soon indicate whether you need stock different-capacitance holders for certain units.

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*Bendix Corp., Marine Dept., 8211 Lankershim Blvd., No. Hollywood, Calif.

**CRC, 116 Chestnut St., Philadelphia, Pa.

†Petersen Radio Co., Inc., 2800 W. Broadway, Council Bluffs, Iowa.

Vibrators are needed for radiotelephones and depth sounders. Some Bendix sounders use special ones available only from Bendix; however, following types will handle most requirements: 1016248 (Bendix), G1501 (12 v), 1601 (6 v), G1601 (12 v), 292-3904G2 (Raytheon, 60 cycles) and 115 cycles, 4-prong synchronous from Sonar.‡

Neon bulbs in depth sounders need frequent replacement. NE-51H's will repair White Echo Sounders, and stock of replacement bulbs (NE-2 type) from Sonar will do for most other makes. Special bulbs are used in some Bendix and Raytheon models. These must be obtained from their manufacturers; however, they do not need replacement often.

Radiotelephone service

The most common radiotelephone complaint: "They can't hear me!" If modulation is present with low rf output, check the antenna system first. Corrosion where lead-in wire attaches to antenna can make a bad connection despite a tight mechanical joint. Cleaning wire end, bolt and antenna surface thoroughly corrects this problem. Spray CRC over finished job to prevent future corrosion.

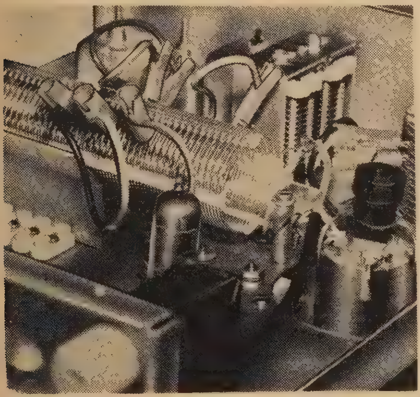

Fig. 3—Variable capacitors (at far end of chassis) are used in this model to tune two highest-frequency channels.

Corrosion also breaks continuity between antenna sections, especially on aluminum antennas. Loading coil connections suffer likewise. Check for resistance by connecting your ohmmeter (on R × 1 scale) to bare metal on each side of suspected joint. Any resistance reading indicates need for repair (Fig. 1).

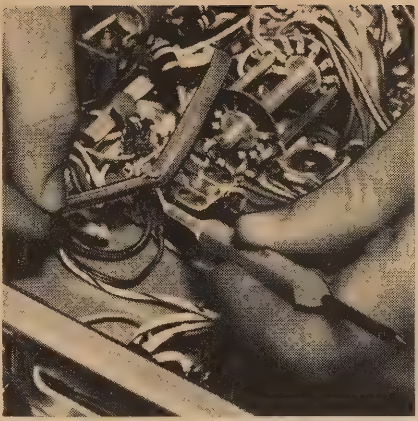

Fig. 4—Use folded strip of crocus cloth (abrasive side out) to clean both halves of relay contact simultaneously.

Repeak transmitter and antenna tuning after cleaning or otherwise altering antenna circuit. Most marine rigs tune both plate tank and antenna coil with movable coil taps (Fig. 2). Better outfits have variable capacitors to supplement taps in plate circuits (Fig. 3). Some use third tapped coil for antenna loading adjustments, but most have trimmers. If the transmitter lacks a milliammeter, it will have chassis jack (sometimes well hidden) for connecting your portable meter.

Always tune highest channel first, working downward in frequency, to minimize detuning of previously tuned channels, regardless of channel number sequence used. Standard color-coding of channel tap wires is shown in table.

Remove antenna and set all load adjustments to mid-position. Remove tank coil taps. Grasp highest-frequency tap by plastic insulator and, while keying transmitter with your other hand, move tap carefully from turn to turn on coil, starting at plate end, until you read minimum plate current. Tighten tap at that point and, if there is a variable capacitor, tune for final dip. Repeat for all channels in order of descending frequency. Be careful to keep hands off output tube plate cap and other nearby high-voltage components. High-powered rigs have a "low-power" switch for tuning.

Attach antenna lead and again key transmitter on highest channel. If plate current exceeds rating, reduce coupling by adjusting load tap or trimmer until current is below normal. Keep transmitter "on" periods brief. Then remove antenna coil tap for same channel and move it up or down antenna coil for maximum field strength. Finally readjust load trimmer (or tap) for rated plate current. If normal current cannot be obtained, plate tank Q is wrong. Moving plate coil tap one or two turns up or down and retuning will correct Q, after which antenna loading will produce proper input. Repeat procedure for each channel in order of descending frequency.

A few transmitters (especially some Hartman models) have considerable interaction of antenna tuning and plate tank resonance. You will have to make several "redippings" of plate current as proper antenna loading is reached.

Old radiophones sometimes become intermittently weak because of corrosion between coil and taps. Tuning an old rig by tap selection is often impossible without thoroughly sanding tap clip and all coil turns.

Check fuses if rig is dead. In addition to fuses on chassis, fuses are often installed in the battery line in engine compartment. Often main power is handled by relay, controlled by transmitter on–off switch. Burnt and dirty relay contacts are frequent troublemakers. Fig. 4 shows one method of cleaning contacts. Fold an 8-inch strip of crocus cloth to form a 4-inch strip with abrasive on both outside faces. Using suitable tool to push contacts gently together, draw strip between them, cleaning both points simultaneously. Repeat several times on each set of points to insure good contact.

STANDARD CHANNEL-NUMBER COLOR-CODES

Channel	Color	Channel	Color
1	brown	5	green
2	red	6	blue
3	orange	7	violet
4	yellow	8	gray or white

Coding follows standard resistor-capacitor code except for omission of 0 and 9.

Transmitter oscillators are untuned and rarely give trouble. If grid drive seems weak on one channel, try new crystal. (New crystal must be frequency-checked.)

Modulation loss is common. Sometimes modulator or driver tubes or transistors fail. More often, cause is damaged mike cartridge or broken wires in microphone cable or fittings.

Radiotelephone circuits are simple and reliable. "Tough dog" service problems are almost unknown. If one occurs, it is usually in the receiver section. Beware of units that have been hit directly or indirectly by lightning. Never under any circumstances estimate repair on such a job. There are too many good but weakened parts you'll be held responsible for when they fail soon after repairs.

The next article in this group will cover the installation and troubleshooting of depth sounders. END

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‡Sonar Radio Corp., 73 Wortman Ave., Brooklyn 7, N.Y.

by Jack Darr
Service Editor

Service clinic

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 10011.

WHILE WE'RE TRYING TO DIAGNOSE trouble, we're thinking about inductance, resistance and capacitance. Which one is "bad"? Well, you don't have to worry about *one* thing: capacitance. Not capacit*ors*—capacit*ance*. Why? Resistors can change in value; inductors can short and change inductance; but capacitors change capacitance? Nay, nay—never! (With the inevitable exception that proves the rule, of course.)

Capacitors are prone to numerous troubles: they leak, they short, they open, but they don't change capacitance—at least not enough to throw the circuit out of operation. To change the value of a capacitor, you'd have to open it, add or take off some of the "plates" or foil, and reseal it! The only thing it is likely to do along these lines is open completely. This, of course, can be checked very easily by bridging a duplicate unit across the suspected one. Would that all other tests were as simple!

So, while you're doing your diagnostic thinking about a circuit, leave this one thing out of your mind. It'll leave it just that little bit less cluttered and, goodness knows, we can always use that. There are plenty of things to confuse us as it is.

By all means suspect *every* capacitor in a circuit of being leaky, shorted or open. These are things that *can* happen, and do. So, aim your thinking at these possibilities; think of the possible effects of a few volts leakage through a capacitor into a very high-impedance grid circuit; the effect on grid bias of a dead short in a capacitor, or what would happen if a vital bypass were to open, and so on.

The one exception? The electrolytics. As the fluid or paste in them dries out, they *can* and do change capacitance. This plays hob with the filtering efficiency. So, *always* suspect electrolytics of changing capacitance, and always of going *lower*. Here again, we have a quick check: bridge a good one across the suspect and see if you get rid of some of the troubles you're working on. If it's a multiple unit, disconnect the one you suspect and bridge the circuit with a good one. This eliminates the chance that there was leakage between units.

See if this doesn't help just a little.

TV remote control trouble

A customer brought in an Admiral TV with remote control. Channel-change bar wouldn't work, but volume-control bar worked fine. I checked everything in the set, but no results. He left town with the set before I could find the trouble! What do you think it was?—W. S., Saco, Me.

This would almost have to be one of two things: either a mistuned "bar" in the transmitter or something in the double relay in the remote unit. Since one function is OK, one side of the relay must be working. I'd then suspect a dirty relay contact on the other side.

Also, the transmitter bar, which is basically a *bell,* could be out of tune. This would give you *sound,* but at the wrong frequency! So this particular function wouldn't work. I remember a very similar instance on a Zenith supersonic remote control, with four bars. One didn't work. Finally, I took the unit apart and found a bit of *chewing gum* on the side of this bar! Threw it out of resonance far enough so that it would not close the relay! A crack or chip out of a bar or misadjustment of the holder will do the same thing. Even though you can hear the bar ringing, check to be sure that it's ringing at the right frequency!

Hum bar

I have replaced the picture tube on an Admiral 20Y4BF. Now the picture has a very black bar across the bottom and very bright retrace lines at the top. Only about two-thirds of the picture is visible. I can't find a vertical-size control on this set either.—J. F. S., Cleveland, Ohio

This could be double trouble, but your worst trouble right now is in that hum bar. The picture is being blacked out at the bottom and brightened at the top by 60-cycle hum in the video. This is verified by the fact that there is only a single bar. Power-supply trouble would cause 120-cycle hum, making two dark bars.

The first step is to replace the tubes that could cause this (by developing heater–cathode leakage), the 6S4 vertical output, 6BH8 vertical oscillator, the 6AW8 video amplifier and the tubes in the tuner and video i.f.

If this doesn't help, check the electrolytic capacitors which could allow hum to feed into the video. These would be the 10-μf from the 6S4 cathode to B-plus boost; the 5-μf capacitor on the video amplifier screen grid; the 20-μf capacitor from the 6S4 cathode to ground, and the power-supply filter capacitors.

A scope is a great help in locating this kind of trouble. Simply check all of your B-plus supply lines and voltage taps, looking for unusually high hum levels. Anything above about 0.5 volt should be viewed with suspicion!

There *is* a vertical height control on this Admiral chassis, by the way. It is a 2.5-meg pot in the plate circuit of the 6BH8 vertical oscillator and is located right underneath the 6CU6 horizontal-output tube, looking from the back of the chassis.

The 21ALP4 tube is electrostatically focused. Be sure to set the ion trap for maximum brightness, then move it slightly around the neck of the tube, watching the scanning lines, for best focus.

Modern record player for old Philco

I have a Philco 42-1013 radio–phono combination for repair. The set is all in good shape now, and I want to add a modern record changer. It works, but the tone quality is awful. What am I going to have to do to get better tone?—L. D., Erlanger, Ky.

This was the model that used the Beam-O-Lite pickup. It had a tiny photoelectric cell in the pickup head with an exciter lamp. A mirror on the stylus varied the amount of light falling on the cell (Fig. 1). Of course, the output of this was pretty low. So a matching transformer and a pretty high-gain preamp were used.

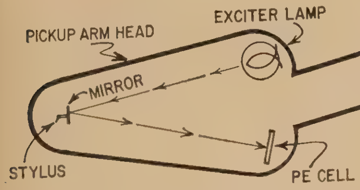

Fig. 1—Philco Beam-o-Lite cartridge used exciter lamp powered by ultrasonic oscillator on amplifier chassis.

This is the 7C6 tube at the left front corner of the chassis. The transformer is a separate unit in a heavy iron case, and is usually mounted on the cabinet, with a shielded lead to the chassis. Fig. 2 shows the original circuit.

Your basic trouble is simply too much input from the modern cartridge. The preamp is overloading. (I had the same trouble in several of these sets.) So, just cut the gain down.

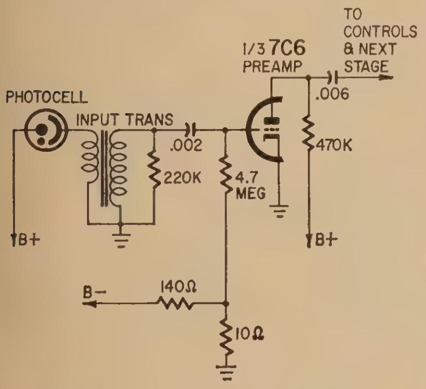

Fig. 2—Original Beam-O-Lite circuit.

If you have a high-output cartridge, skip the preamp entirely and go into the XXFM audio tube (pin 3's the grid). If not, reduce the plate load on the 7C6 preamp. This is 470,000 ohms now. Break this up into *two* resistors, as shown in Fig. 3, and bypass the junction. This reduces the gain by lowering the plate load resistor.

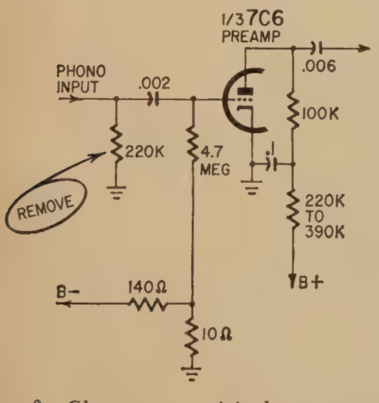

Fig. 3—Changes to original preamp to make is usable with ceramic cartridge.

Watch out for the bias on the 7C6. Its grid returns to a negative point on the voltage divider in the B— circuit, a 140- and a 10-ohm resistor network from center tap of the power transformer high-voltage secondary to chassis.

The 7C5 tube nearest the oscillator trimmers in the center of the chassis is a supersonic oscillator used to feed the exciter lamp; take it out.

Flyback arcing in KCS-68

The anode of the 6CD6 arcs over in an RCA KCS-68C. It won't blow the fuse, but it'll eat up the flyback if I leave it on! I've got −20 volts on the grid of the 6CD6, and all other voltages seem to be OK.—R. C., Philadelphia, Pa.

This could be insulation breakdown in the flyback, since this set runs rather high peak voltages. I'd recommend spraying with an acrylic plastic, using at least three coats, well dried between applications. Or try the High-Voltage Putty insulation made by Colman.

The drive voltage sounds just a little low to me. I'd check the horizontal oscillator, and the settings of the drive and horizontal linearity controls. Adjust for minimum cathode current on the 6CD6, with a 0–500 dc milliammeter in series with the cathode. Arcing over like this is often due to slight overheating of the flyback, which softens the wax and makes the arcing "easier" for the high voltage.

You might also try one of the "beefed-up" flybacks made by Triad and others. A D-53 fits this set, I think.

Intermittent focus and raster

I have an RCA color TV, model 21CD-7999. Everything is fine for a few minutes after it's turned on. Then the screen brightens, gets very reddish and goes out of focus. Now and then it goes completely dark. I can sometimes turn the brightness up and get the picture back.—G. M., Orlando, Fla.

From experience with similar cases, I'd suspect an intermittent damper tube. Also, the reduction of boost voltage, with the decrease in load on the flyback, apparently changes the focus by changing the voltage applied to the focus rectifier. I'm not quite sure about the exact cause of the "red shift," but it probably has something to do with the loss of boost voltage.

Also, you could have a defective red amplifier or green amplifier. Here, the reddish tint would be due to a loss of green, not an increase of red. END

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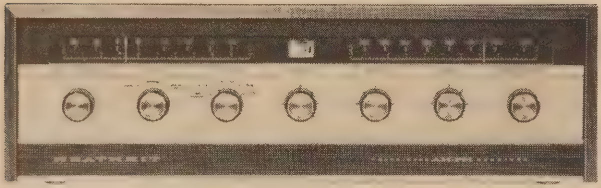

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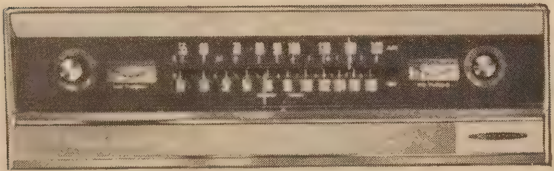

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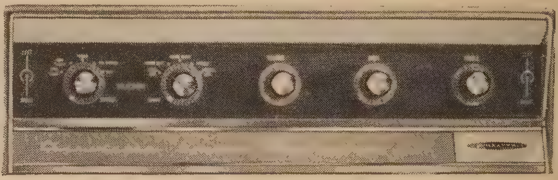

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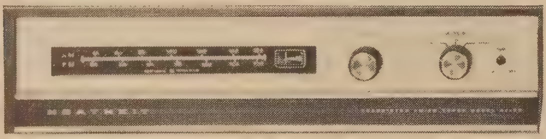

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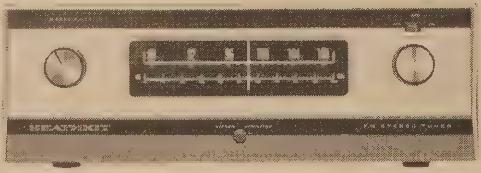

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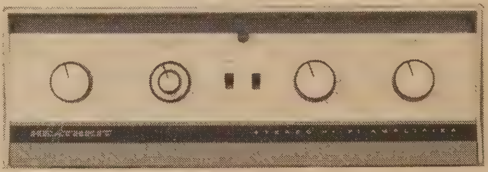

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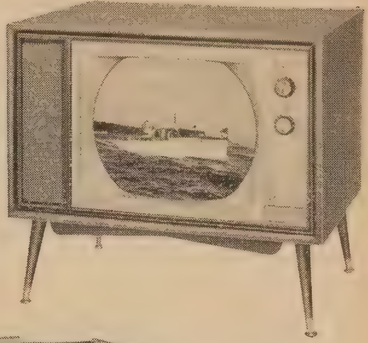

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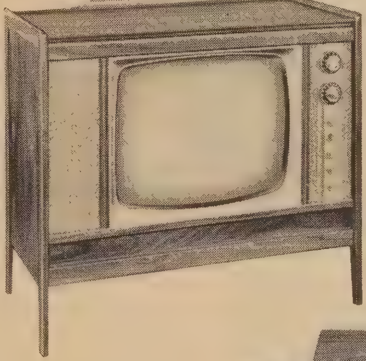

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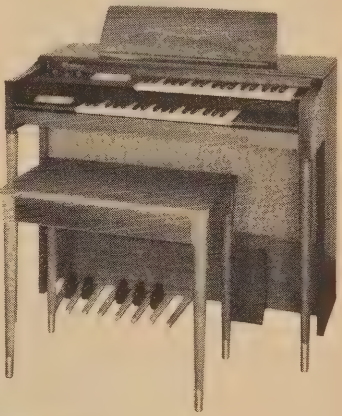

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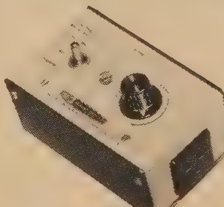

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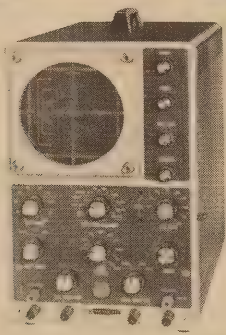

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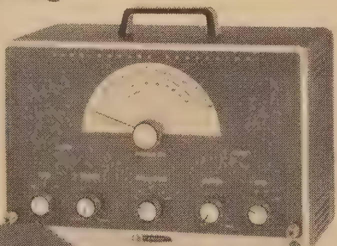

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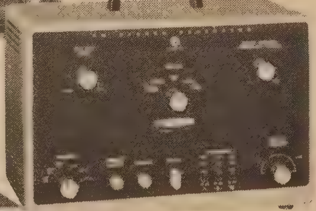

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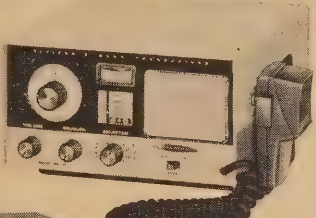
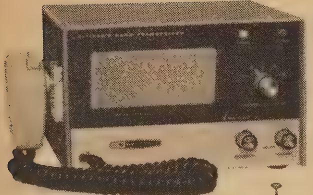
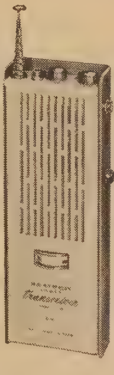


MW-34 $89⁹⁵

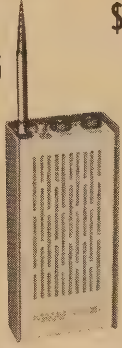


GW-22A $59⁹⁵

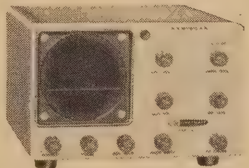
GW-52 $74⁹⁵



GW-21 $44⁹⁵



GW-31 $19⁹⁵



HO-13 $79⁰⁰

Deluxe "Master Station" Transceiver GW-42 . . . $119.95—Operates "mobile" or "fixed" with built-in 3-way power supply. Other deluxe features include 5 crystal-controlled transmit & receive channels, built-in 4-tone selective call circuitry, all-channel receiver tuning, tuning meter, adjustable squelch, switchable automatic noise limiter. Complete with AC & DC power cables, PTT microphone, and crystals for 1 channel (specify). 23 lbs.

New Versatility! 2-Way Citizen's Band Radio MW-34 . . . $89.95—Provides 5 watts of input power for reliable communications from boat to boat, car to boat, car and home. Features 5 crystal-controlled transmit-receive channels (one transmit crystal on front panel); variable receiving tuning with spotting switch; 3-way power supply (6 or 12 V. DC or 117 V. AC); RF stage for superb reception; and attractive black, white, & blue Heathkit marine styled cabinet. 19 lbs.

5-Channel Citizen's Band Transceiver GW-22A . . . $59.95—Low cost! Ideal for business or personal communications. 5 crystal-controlled transmit & receive channels; superheterodyne receiver with RF stage; built-in squelch & automatic noise limiter; PTT crystal microphone; and crystals for one channel (specify). GW-22A (117 v. AC, less selective call). GW-22D (6 or 12 v. DC, less selective call) . . . $64.95. 14 lbs. GW-32A (117 v. AC, with selective call) . . . $84.95. GW-32D (6 or 12 v. DC, with selective call) . . . $89.95. 15 lbs.

Powerful 1-Watt "Walkie-Talkie" GW-52 . . . $74.95 each—10-transistor, 2-diode circuit; 3-mile inter-unit operation; crystal-controlled transmit & receive; rechargeable $20 battery; built-in 117 VAC battery charger; FCC license pack; crystals for 1 channel (specify). 4 lbs.

Deluxe 9-Transistor "Walkie-Talkie" GW-21 . . . $44.95 each—1 to 3 mile operation range; portable—battery powered; crystal-controlled transmit/receive; superhet receiver; built-in squelch & automatic noise limiter; crystals for 1 channel (specify). 3 lbs.

Low Cost 4-Transistor "Walkie-Talkie" GW-31 . . . $19.95 each—1-mile operation; crystal-controlled transmitter; super-regenerative receiver; 75 hour operation. Only $35.00 a pair! No license, forms, tests or age limit. Less battery. Crystals for 1 channel (specify). 2 lbs.

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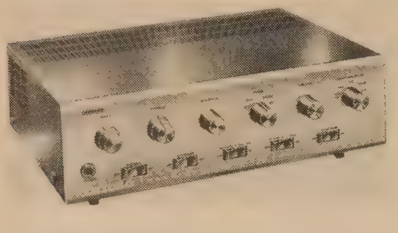
CL-7

Lafayette LA-200 Transistor Stereo Amplifier



THIS IS A HONEY OF AN AMPLIFIER. Small, light, clean-sounding—and absolutely ice-cold. It measures only 13 inches wide by 4¼ high by 9 deep, and weighs less than 14 pounds. There is no apparent rise in cabinet temperature after hours of operation in a warm room.

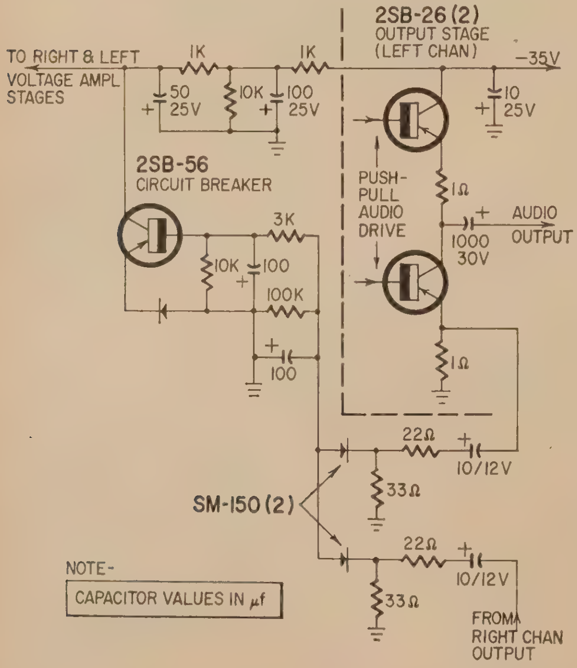
The LA-200 delivers, at moderate levels, the kind of sound that has come to be associated with good transistor amplifiers (and with many tube amplifiers, too): crisp transients, sharp reproduction of plucked string bass and clear quality of extremely complex sounds, like a full orchestra or a pipe organ playing *fortissimo*. At high levels, the sound muddies up a bit.

Which brings me to my chief criticism: the specifications do not tell all. For one thing, the specified power of 22 watts per channel is IHF music power. Continuous sine-wave power is only about 15 watts at mid-range, tapering off to 10 or less at extremes. Further, the specified power is delivered only into a 4-ohm load, which includes only a few quality speakers. An 8-ohm load cuts the power approximately in half, and a 16-ohm load about in half again. But I used the amplifier only with 8-ohm speakers on each channel, and the sound, subjectively, was very satisfying.

The probable reason for the big difference between music power and sine-wave power is the absence of a regulated power supply. But that, on the other hand, accounts for the small size and low cost of the amplifier. You can't have it all ways!

One of the most attractive points of the LA-200 is its foolproof output circuit. Go ahead, short the speaker terminals—all day, if you like. The sound "turns funny"—comes and goes intermittently, and the pilot light dims accordingly, but this will go on indefinitely until the short is removed. Egged on by the confidence of the instruction manual, I tried everything I could think of to make the amplifier cry "Uncle!" but it wouldn't.

All controls and switches have an uncommonly smooth feel, as though they are all viscous-damped. The tone controls are "split," as you can see from the photograph (the two leftmost knobs), so that you can adjust bass and treble individually for each channel, to compensate for speaker differences. The switches along the bottom row are all rocker-action types, which is fun. All you have to do is squint and aim a stiff finger at the switch and position you want, and *phffft!*—the volume control is loudness-compensated, or the rumble filter is in, etc.



The 2SB-56 electronic circuit breaker in the LA-200 protects output transistor against shorts in the speaker circuit by removing collector voltage from the voltage amplifiers in the first stage of both power amplifiers.

SPECIFICATIONS

(The manufacturer's)

IHF Music Power: 22 watts per channel
Frequency response: ±1 db, 20–20,000 cycles
Harmonic distortion: 1%
Hum & noise: Tuner input, −74 db; mag. phono input, −54 db
Tone controls: ±10 db
Inputs for tape head, magnetic phono, ceramic phono, tuner and auxiliary high-level source.
Outputs for speaker and tape recorder.
Price: $109.50

A few things might have been done differently, for my taste (but this is almost carping): The action of the controls, though velvety, is fairly tight, and the knob surfaces are *so* smooth that my fingers kept slipping a little. Fluted knobs, or ones with a knurled band around them, would probably be just as handsome and a lot easier to grab.

I missed a "mono" position: one in which the channels are tied together for monophonic listening from both channels of a stereo cartridge. That kills a lot of surface noise. Instead, LEFT, RIGHT and REVERSE positions are provided besides the usual STEREO.

The rumble and scratch filters are effective, but a little drastic. There is a very prominent loss of bass and treble, respectively, when they are switched in.

I appreciated the headphone jack on the front panel, with a speaker on–off switch. The speaker phasing switch in back is handy to have, too.

Technicalia

The output stage of each channel is fairly conventional – a "single-ended push-pull" connection of two p-n-p power transistors. The speaker is connected to the junction of the upper transistor's emitter and the lower's collector through a 1,000-μf capacitor to keep the speaker and the dc operating voltages out of each other's hair. (That 1,000 μf is a bit small for a 4-ohm load, which no doubt accounts for a little falling off of power below 100 cycles.)

The protective circuit is ingenious. It is basically an electronic circuit breaker in the collector supply to the input stage of the left and right power amplifiers. A sampling of each channel's audio is taken from across a 1-ohm stabilizing resistor (see diagram) in the emitter of the lower transistor of each push-pull output pair. This is rectified to a negative dc voltage with respect to ground, and applied to the base of a p-n-p transistor. The emitter of that transistor is grounded through a silicon diode, and its collector is connected to the power supply point for the first "main amplifier" stages.

When the biasing (from the rectified audio signal) exceeds the small forward threshold voltage of the diode and transistor, the transistor conducts, shorting to ground the supply at the point where the collector is connected, and cutting off the sound. This happens only when the audio signal current through the stabilizing resistors (and the voltage across them) is greater than in normal operation at maximum power. It would be if the output terminals are shorted while the amplifier is being driven.

Because of the long time-constant of the protection circuit, the audio comes and goes at regular intervals of about a second until the short is cleared. Works like a charm.—*Peter E. Sutheim*

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Because our engineers realize that **no** single antenna design is the answer to **all** UHF reception conditions.

UHF frequencies are more adversely affected by surroundings. Degradation due to receiver noise is greater on UHF. Also, UHF signal losses are greater than VHF.

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For Fringe Areas up to 60 miles

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26° to 29° narrow "E" plane (horizontal) beamwidths eliminate ghosts resulting from horizontal reflections—and combine with . . .

"H" plane (vertical) beamwidth, as low as 40°, to give over-all high gain.

- Exclusive new UHF **Log-Periodic frequency independent** design provides **flat, high gain across the band**—excellent 300 ohm match gives **below** 2:1 VSWR.
- **30% to 50% more effective gain and directivity** than corner reflectors and stacked bowtie-screens on UHF channels 14 to 83—plus a bonus VHF gain of up to 6 db on channels 7-13.
- **Inline solid aluminum rod construction** for least wind and ice loading area.
- Beautifully **gold alodized** for lasting eye appeal.
- **100% pre-assembled**—nothing to swing out or tighten—no movable joints.
- Stainless steel take-off terminals.

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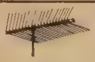
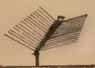
	Model	**Range**	**Outperforms**	**List**
	LPV-U21	up to 80 miles	12-bay bowtie-screen	$27.95
	LPV-U15	up to 60 miles	8-bay bowtie screen	18.95
	LPV-U9	up to 40 miles	4-bay bowtie-screen	12.50
	LPV-U5	up to 25 miles	corner reflector	6.95

JFD UHF ZIG-A-LOG LOG-PERIODIC UHF ANTENNAS

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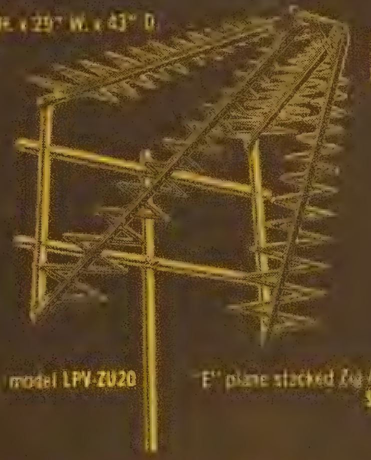
- Outperforms 8 Bay bowtie screen reflector antenna.
- Ultimate in corrosion-protection: Gold alodized aluminum elements . . . Rohm & Haas Implex & square crossarm . . . stainless steel take-off terminals.



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THE "INTEGRATED" COMBINATION OF preamp and amplifier in a single package dominates the hi-fi market so completely that most manufacturers no longer offer independent amplifiers and preamps.

SPECIFICATIONS

(All specifications are the manufacturer's)

Power output: 100 watts IHF. Each channel 50 watts; 35 watts per channel continuous sine wave.
Frequency response: ±½ db, 20–25,000 cps.
Harmonic distortion: 1%.
Hum & noise: —80 db, tuner and aux.; —65 db, phono and tape inputs.
Sensitivity: 0.1 v, tuner and aux; 2.5 mv tape; 2 mv phono inputs, for full rated output power.
Outputs: 4, 8, 16 ohms per channel to speakers; hi-z center channel; hi-z to stereo recorder; lo-z to stereo headphones.
Dimensions: 4½ x 13⅞ x 12¾ inches
Weight: 20 lb
Price: $179.95 less case

With rare exceptions, integrated units have failed by several notches to meet the standards of fidelity the state of the art permits, and which are often met by even moderately priced combinations of independent units. Power output has been low, and often only half the rated power has been available at high and low ends of the audio range. Distortion has been high, especially at the bottom end, and transient response poor. Even the best never crossed the line that separates the merely good from the superb.

It is in upgrading this type of equipment that the transistor can make its greatest contribution, as the Knight KN999 amplifier admirably shows.

Capable of delivering 35 watts sine-wave power per channel, the KN999 is one of the two or three most powerful integrated units on the market. It delivers nearly full output over the full audio range—down less than ½ db at 20 and at 20,000 cycles. Harmonic distortion at maximum output averages 1% over the whole range; IM distortion is just over 2%. In terms of measured characteristics, the amplifier misses the top rung in only one respect: distortion is almost as high at low levels as at maximum output.

But that seems to be true of almost all transistor amplifiers, and seems to be the price we have to pay, at present, for the benefits transistors bring. The low-level distortion is not too much higher than in comparable tube type integrated units, and the benefits more than compensate.

This is the first integrated amplifier I have used which gives a "big amplifier" sound. Transient response is superb, the reproduction of the bass instruments awe-inspiring, and the definition of detail notably superior.

The control facilities are elaborate. I commend especially the use of pushbuttons for selecting input sources—not only simpler and more convenient than a rotary switch, but less likely to produce transistor-destroying and ear-annoying transients. There are only four knobs on the panel: BASS, TREBLE, BALANCE and LOUDNESS. The bass and treble controls for both channels are ganged. Eight slide switches control power, choice of mono or stereo, channel reverse, phase reverse, high- and low-cut filters, loudness compensation and tape monitoring. The two high-level inputs (tuner and auxiliary) have ganged input level controls. There is a high-impedance center-channel output jack to feed another amplifier for center-channel fill, or to provide monophonic sound (via an additional amplifier) for remote speakers. A jack on the front panel accommodates low-impedance stereo headphones. There are phono jacks in back for tape output.

The circuitry is simple, compared to many other transistor amplifiers. Two transistors in a feedback pair, with equalization in the feedback loop, constitute the low-level preamp section of each channel. Loudness compensation, high-cut and low-cut filters are simple passive R-C networks. An emitter follower feeds the bass and treble tone-control networks, similar to the tube type Baxandall circuit (also included in a feedback loop).

A driver feeds the "single-ended push-pull" output stage through a transformer to provide balanced input. Four transistors are used in each output stage. They are protected against excessive drive by shunt diodes at the input. The feedback loop goes from the output to the emitter of the driver stage. The voltage to the low-level stages is regulated by a series transistor regulator.

The power transformer has a tapped primary with 117- and 127-volt inputs. It arrives with the line connected to the 127-volt tap. This provides considerable protection against high line-voltage surges. In locations where the line voltage is below 120, the amplifier will not deliver its full rated output power as it comes. The input can, however, be shifted to the 117-volt tap.

A thermal circuit breaker breaks the power circuit if the ambient temperature rises to the danger point.

Two ac outlets controlled by the power switch are available at the rear so a tuner, tape recorder or whatever can be turned on and off along with the amplifier.—*Joseph Marshall*

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3BZ6	56	6BN8	.76	12AU7	.61
3CB6	.56	6BQ6	1.12	12AV6	.41
3V4	.63	6BQ7	1.00	12AX4	.67
4BQ7	1.01	6BS8	.95	12AX7	.63
5AT8	.83	6CB6	.55	12AZ7	.86
5CG8	.81	6CG7	.61	12BA6	.50
5CL8	.76	6CL6	.94	12BE6	.53
5U4	.60	6CY5	.70	12BH7	.77
5U8	.84	6DQ6	1 10	12BL6	.56
5Y3	.46	6EA8	.79	12BY7	.77
6AF4	1 01	6J6	.71	12SK7	.95
6AH6	1 10	6K6	.63	12SQ7	.91
6AK5	.95	6L6	1.06	25BQ6	1.17
6AL5	.47	6S4	.52	25L6	.57
6AM8	.78	6SL7	.84	35C5	.51
6AN8	.93	6SN7	.65	35W4	.42
6AQ5	.53	6SQ7	.94	35Z5	.60
6AS5	60	6T8	.85	50C5	.53
6AU4	.85	6U8	.83	50L6	.61
6AU6	.52	6V6	.54		

TERMS: 25% deposit on all orders, balance COD. Orders under $5 add $1 handling charge plus postage. Orders over $5 plus postage.

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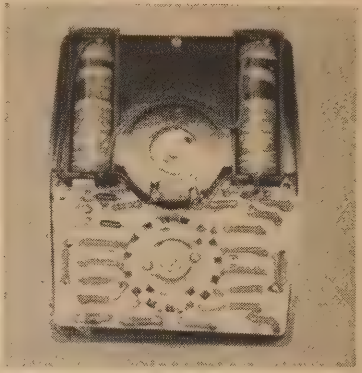
test equipment reports

Olson TE-179 multitester is flat and compact.



Every inch of space inside case has been used intelligently.

Olson TE-179 30,000-ohm-per-volt Multitester

A TRULY VERSATILE POCKET-SIZED VOM is always good news. With the Olson TE-179, which has ranges from 0.25 to 1,000 volts dc, you can measure low base-to-emitter potentials or high plate voltages—at 30,000 ohms per volt, ±3% of full scale.

Ac ranges are from 10 to 500 volts, in four ranges, at 12,000 ohms per volt, ±4% of full scale.

Twenty-five years ago, 1,000 ohms per volt was the common meter resistance. Advances in electronics have demanded higher and higher meter sensitivities. Most of this is due to the smaller tolerances allowed—20% resistors were good enough for radio receivers. Now 5% resistors are used in some TV circuits and 1% components are found in many nonentertainment electronics devices.

The additional current drain caused by putting test prods across a resistor can make a circuit inoperative during the test and indicate trouble where there is none. It can cause completely erroneous meter readings.

High-sensitivity meters reduce the loading on a circuit. For example, any 20,000-ohm-per-volt meter will draw 50 μa for a full-scale reading on any range of 1 volt dc or higher. At 30,000 ohms per volt the current drawn by the meter drops to 33 μa.

The pocket-sized Olson TE-179 is not much larger than most transistor radios. At 4⅝ inches high, 3½ inches wide and 1⁷⁄₁₆ inches thick it is smaller than many.

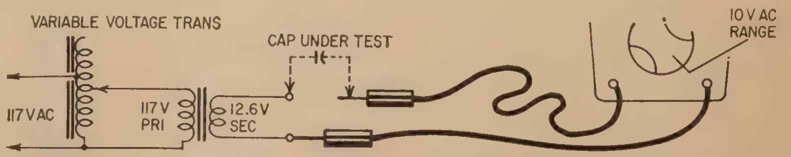
The 18 basic ranges can be increased to 22 by using the furnished tables and charts. These add three db ranges and one for capacitance measurement from .001 to 0.2 μf.

Capacitance is measured by using a 10-volt source and the 10-volt ac range on the meter. For most accurate readings the 10-volt ac source should be adjustable—it is set for a full-scale reading with the circuit completed. Just like zeroing an ohmmeter.

The circuit is then opened and the capacitor connected into it. Read the meter and look up the reading on the chart.

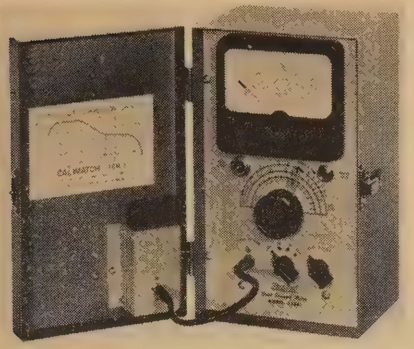
Keeping semiconductor testing in mind, the manufacturer even gives a basic schematic showing the polarity of the voltage at the test prods in the ohmmeter ranges. This is also important when checking circuits containing electrolytic capacitors—particularly those with low working voltages. The ohmmeter circuit is powered by two 1.5-volt penlight cells.

The instruction manual contains many other items on how to get the most use from this high-sensitivity handful. It costs $13.92.—*Elmer C. Carlson*



The Olson TE-179 measures capacitors by reading ac voltage passed by capacitor in series with external ac source. Meter reading is converted to capacitance with help of chart supplied.

Hickok 235A Vhf/Uhf Field Strength Meter



Hickok's new 235A field-strength meter is a compact, battery-operated instrument, using a 3A5 twin-triode tube. Like the new TV sets, it's "all-channel", covering vhf and uhf. It's a superheterodyne, with a crystal mixer; half the 3A5 is used as an oscillator; the other half is a superregenerative i.f. amplifier at 40 mc.

The i.f. amplifier works in the logarithmic mode; its plate current varies in proportion to the *logarithm* of the signal voltage on its grid. This gives a logarithmic scale on the meter, which is a 200-μa unit connected in a bridge circuit in the plate of the i.f. tube.

The amplitude of the superregenerative oscillation is adjusted to zero the meter. Two variable inductances are used: a coarse adjustment, inside the case, and the fine adjustment on the panel, marked ZERO ADJUST. Hickok claims ±3-db accuracy on the vhf bands and +6, −2 db on uhf. Most of the error will be at the ends of the scale; accuracy is very good in the most-used center part.

Power comes from a 90-volt B-battery and two 1.5-volt A batteries. Since the plate current is in microamps, battery life should be good. An NE-51 neon lamp on the panel is used as a pilot light and battery-condition indicator. It's also the voltage regulator! Connected in the meter circuit, the firing voltage of the lamp regulates the plate voltage of the i.f. tube and the bridge. (Neon lamps have firing voltages between 60 and 70 volts, due to manufacturing tolerances. The maker will supply replacement lamps with the correct voltage on request. This is stamped inside the case near the NE-51 socket.)

The meter has three scales: low vhf, high vhf and uhf. Center-scale on the low band is 1,000 μv, on the high vhf band 100 μv, and on uhf, about 800 μv. The first calibration mark (at the left) is 10 on vhf and 30 on uhf. This puts the most-used parts of the scale in the most accurate place, near the center. In strong-signal areas, and in community-antenna work, where signal strengths in thousands of microvolts must be measured, simple resistive pads will bring the readings back to center. A 20-db pad will multiply all readings by 10, and a 40-db pad by 100. Resistor values for making these pads are given in the instruction book.

The 235A has 75-ohm input, through an auto-radio type coaxial jack on the panel. A CM-1 "Calimatch" balun transformer is mounted inside the lid, for 300-ohm inputs. It connects to the 75-ohm input through a short coax link furnished with the instrument. A calibration chart printed inside the lid gives correction factors. On vhf these are very small, but they should be used on uhf for maximum accuracy.

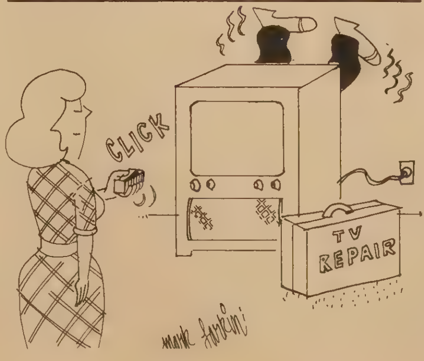
A highly selective input filter gives maximum image rejection on vhf. On uhf, this filter is designed to give the best impedance matching, with a slightly lower image-rejection ratio. Some spurious responses may be found, but they can usually be identified as coming from strong vhf signals. Calibration is extremely close and the tuning is sharp, even on strong signals. An earphone jack on the panel can be used with crystal phones to identify sound and picture carriers, or noise.

The only unfavorable reaction I got on this instrument was from the thumbscrew terminals on the Calimatch balun transformer; they're hard to get at. However, a short piece of 300-ohm ribbon with a two-terminal block on the end, permanently attached, would solve that.

A very clearly written instruction book is furnished. Read it carefully before you use the instrument. That applies to all of 'em, though!

A field-strength meter was a very valuable instrument back in the 'good old days', and if uhf gets going, it will be again. We'll be back on the roofs running up and down hunting for signals, and the fastest way of finding a uhf signal, with its many peculiarities, is a probe antenna and a good uhf field-strength meter.

The meter (price $229.50) is housed in a durable metal case with a handle, and should be easy to work on a roof. Construction (I peeked!) is excellent—well shielded and sturdy.—*Jack Darr*



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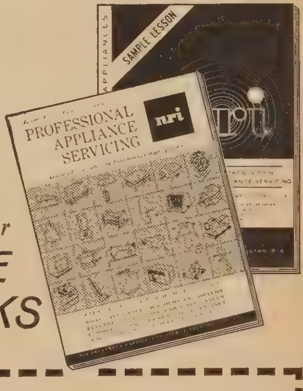

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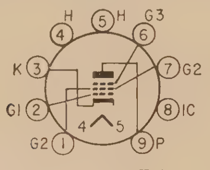
New Semiconductors and Tubes

6JT6, 12JT6, 17JT6

A new family of novar-base beam-power tubes for TV horizontal sweep circuits has been announced by RCA. Alike except for heater ratings, the new tubes feature exceptionally good "knee current" characteristics, making them suitable for low-B-plus applications. (They can draw 390 ma at only 60 volts on the plate, with zero bias.) Also featured are two base-pin terminals for the screen grid, for better heat dissipation, and a separate suppressor terminal, to allow applying a positive suppressor bias to eliminate "snivets."



6JT6,12JT6,17JT6

The "bonded-cathode" feature, according the RCA, "virtually eliminates peeling of emissive oxide coating."

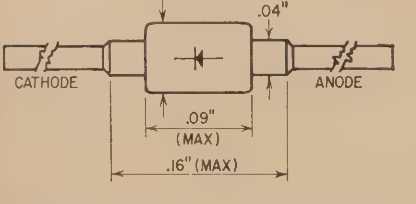
Characteristics, summarized briefly:

	6JT6	12JT6	17JT6
Heater volts	6.3	12.6	16.8
Heater amps	1.2	0.6	0.45

Plate volts	250
Grid 2 volts	150
Grid 1 volts	—22.5
Plate resistance	15,000 ohms
Transconductance	7,100 µmhos
Plate current	70 ma

Tiny 1.5-watt Zeners

The semiconductor division of Hoffman Electronics Corp. has brought out a line of 1.5-watt Zener diode regulators in a new microminiature hermetically sealed glass package. The line bears JEDEC numbers from 1N4460 through 1N4496, and covers voltage ratings from 6.2 to 200. The drawing shows some of the mechanical features of the new diodes.



The active element is an oxide-passivated diffused junction bonded directly to a tungsten heat sink. Contact springs are completely eliminated. Leads are gold-plated silver.

New nuvistor triodes: 8203 & 8393

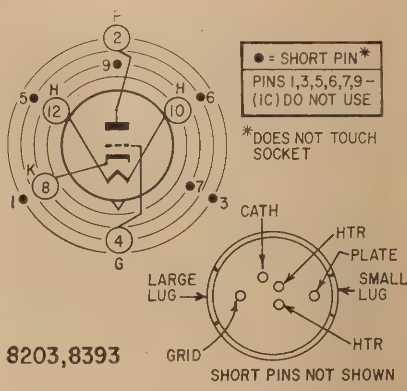
The 8203 is a power triode meant for class-C applications as rf amplifier, oscillator and frequency multiplier, and for dc pulse-amplifier service. Designed to withstand severe shock and vibration, it features all ceramic and metal construction.

Characteristics in class-C service up to 250 mc, continuous commercial service (CCS):

Plate voltage	250
Grid voltage	—100
Total dc cathode current	25 ma
Dc grid current	5 ma
Plate dissipation	1.5 watts

Transconductance in class-A service, with only 75 volts on the plate, is 13,000 µmhos.

The 8393 is a 13.5-volt-heater version of the 7586, a high-gain low-noise amplifier for vhf and uhf work to 400 mc. The two types are identical except for heater rating and interelectrode capacitances. Like many nuvistors, the 8393 features high transconductance (11,500) at low plate voltage (40). Its amplification factor is 35 at a plate voltage of 40. Both tubes are made by RCA.

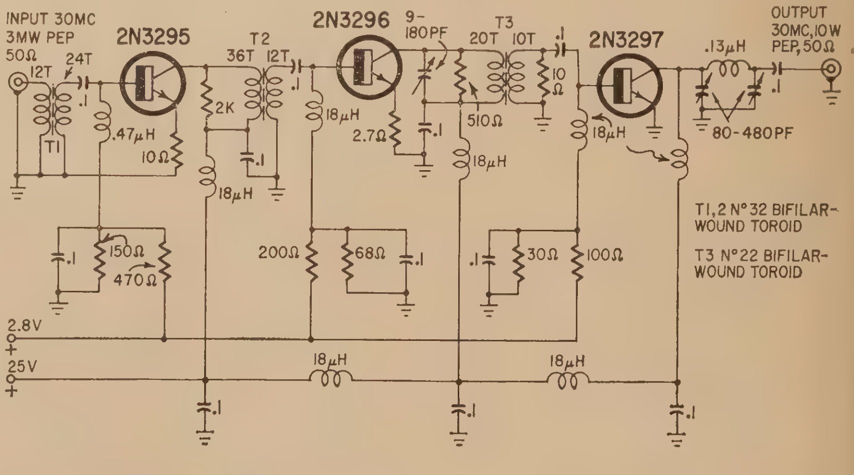


8203,8393

SSB Power Amplifier Transistors

As single-sideband transmission techniques filter down gradually from the lab to the military to the hams and finally even into Citizens-band radio, interest in the subject goes up, and manufacturers devote more time to developing specialized devices to meet new demands.

Transistors haven't been so prominent in SSB, because linear amplification at low signal levels has been a problem. Motorola has just announced a family of three n-p-n silicon transistors developed especially for SSB: a 12-watt p.e.p. (peak envelope power) 30-mc amplifier, a 3-watt p.e.p. driver–amplifier and a 0.3-watt p.e.p. driver–amplifier.



Distortion is claimed to be more than 30 db below output signal level (less than 3%) without feedback, which is better than tubes without feedback can do.

The big brother 2N3297 has a dissipation rating of 25 watts, a breakdown of 60 volts, and, like most silicon power transistors, a low ac current gain of 4 at 50 ms. (Sounds better if you say "12 db power gain," which is true if the supply voltage is held constant!) It is built in a TO-3 case.

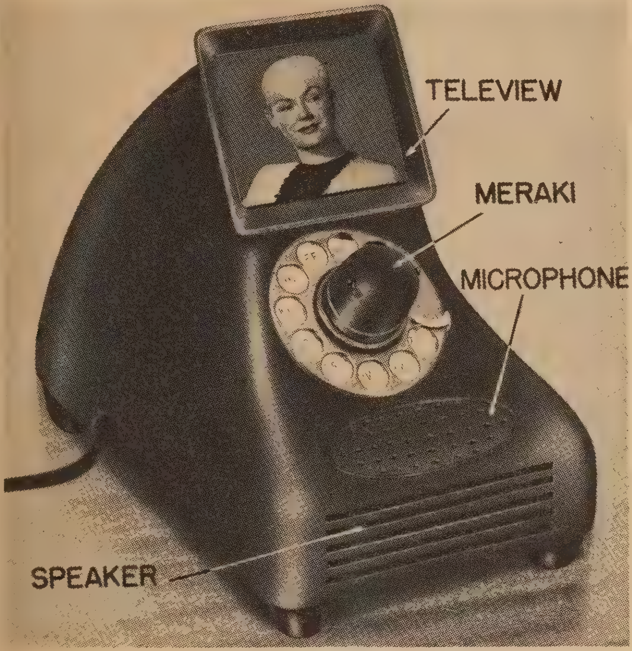
The other two, smaller, transistors, the 2N3296 and 2N3295, differ from the 2N3297 mainly in power rating and case design.

None of these is what you'd call cheap (in terms of the experimenter's pocketbook), but prices will undoubtedly drift down as demand increases. So far, these transistors are being aimed mainly at military and industrial markets.

The diagram shows a circuit designed to use the three new transistors in a 10-watt p.e.p. 30-mc SSB transmitter. The coil and transformer details are not available (the originals were toroids on special cores), but the rest of the parts are conventional and the circuit might serve as a point of departure for experimenting. Coupling between stages should be tight: the original transformers were bifilar-wound. The turns ratios squared will give you an idea of the impedances involved. END

The Photophone In Your Future

continued from page 33



From TAME *Magazine—a parody of* TIME*—published Christmas, 1944. A more up-to-date version of the Picturephone, then called Teleview, as illustrated here. Note the microphone and speaker. Meraki permits dialing from a distance of 10–25 feet. Another Meraki* [Menos (mind)—radio—kinetics] *is worn on the head of the person using the instrument. His brain waves operate the Meraki transmitter, signals from which dial the telephone. The girl's bald head is a proposed hygienic development, supposedly to come by 2044.*

cago and Washington, and $27 between Chicago and New York.

These rates, in the foreseeable future, will naturally come down and will, in all probability, with electronic advances, approach the prevailing long-distance phone charges.

What about other foreseeable *necessary* technical advances of the future? Ralph in the story spoke of a *Language Rectifier.* A great deal of work on this internationally necessary invention has already been accomplished by scores of laboratories all over the world. We would be surprised if the problem were not solved by 1975, at the present rate of progress of the electronic computer.

Probably the next requirement is 3D or three-dimensional TV. We have mentioned this at length and frequently on this page. Anyone who has ever watched a baseball game or other sports has been struck by the inadequacy of the two-dimensional, flat TV picture of our present-day sets. Technicians and inventors know that 3D will be achieved without question in the future. Our own guess: The solution most likely may lie in a *multiple transparent screen* that will show the picture in depth, perhaps with a plurality of split cathode rays.

Finally, the perfected Picturephone, to be universally acceptable, must of necessity be *in full color.*

We can see a vast and unbelievable expansion of the future Picturephone as a shopping instrumentality alone. Here is why:

Shopping today is a major chore—and it will be worse in the future—because of our totally inadequate streets, overcrowded stores, impossible traffic, time loss and general frustration in shopping from store to store.

In the future you will be shopping by Picturephone while you stay either home or at your office. If you are a man, let us say, and you wish to buy a number of ties, you can do it in minutes, thanks to the color Picturephone. You will see everything you buy in full natural colors. If your wife wants to buy a dress or a pair of slacks—she sees them in the real colors. Or she may want to buy a rug, a pair of shoes or what not. *Now she sees what she buys,* without any guesswork. Most of the frustration is now eliminated.

All this, however, is only a single application of the Picturephone.

There are literally thousands of other uses: *"Whenever it is too difficult; too dangerous; too expensive; too inconvenient; too inaccessible; too far; too hot; too cold; too high; too low; too dark; too small to observe directly—use television,"* says an excellent book, *Television in Science and Industry,* written in 1958 by V. K. Zworykin, famed inventor of the iconoscope and the kinescope. And, we might add, *don't overlook the hundreds of new uses of the finally improved future Picturephone.**

Finally and parenthetically, may we delicately but firmly point out one fact to the wildly perturbed lady columnists who, lately *en masse* have denounced the perfectly innocent Picturephone as a nasty electronic ogre and a horrible example of a new infraction of woman's privacy.

The simple technological fact is this: No one, least of all the Picturephone, could possibly intrude on your privacy, *unless you want it to.* There is a button or a switch *you must press first* to become visible to a caller.

No press, no see! See! *—H.G.*

---

*See also the long list of industrial and other uses in *Atypical Television, Radio-Electronics,* October, 1958.

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Dynamic test for all transistors as signal amplifiers (oscillator check), in or out of circuit. Develops test signal for AF, IF, or RF circuits. Signal traces all circuits. Checks condition of diodes. Measures battery or other transistor-circuit power-supply voltages on 12-volt scale. No external power source needed. Measures circuit drain or other DC currents to 80 milliamperes. Supplied with three external leads for in-circuit testing and a pair of test leads for measuring voltage and current. Comes complete with instruction manual and transistor listing.

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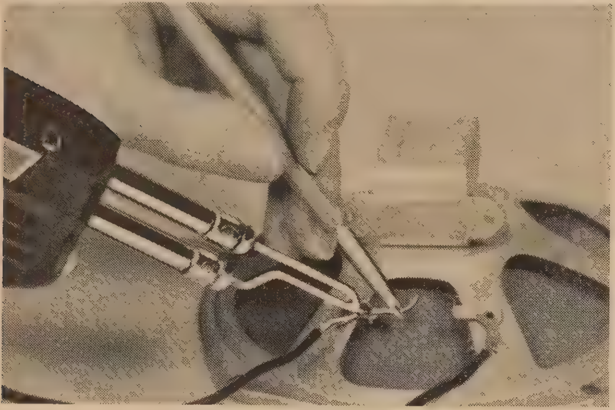
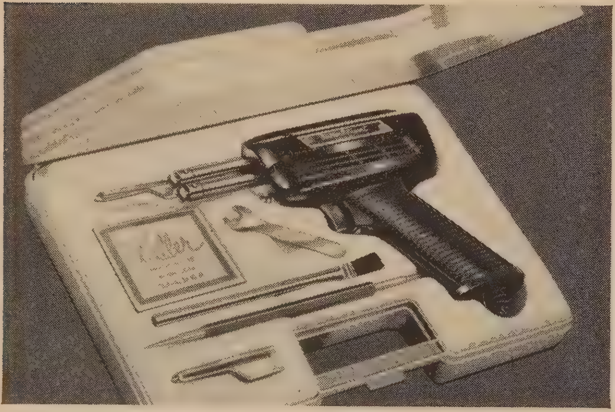


POSITION AND HOLD WIRE
Joint must remain perfectly still until solder sets. An easy way to accomplish this is to hold the wire with a soldering aid. Blowing on solder will speed setting.



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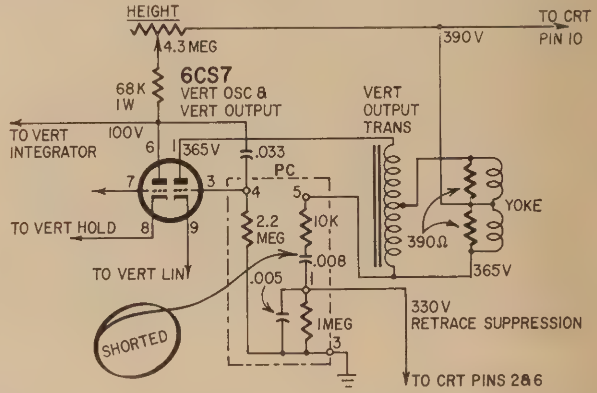
TECHNOTES

PHILCO 9L41U—UNCONTROLLABLE BRIGHTNESS

In this set brightness was always maximum; the control had no effect. CRT checked OK. Retrace lines were visible.

Voltage measurements showed nothing unusual until I came to pin 1 of the printed-circuit R-C network: 330 volts. This was being applied directly to the CRT control grid, causing the brightness trouble. The cause (see schematic) was a shorted .008-μf capacitor in the R-C network. In the Philco 8L41, -42, -43 and "U-suffix" versions, as well as in the 8P51A-U, this capacitor is .005 μf.

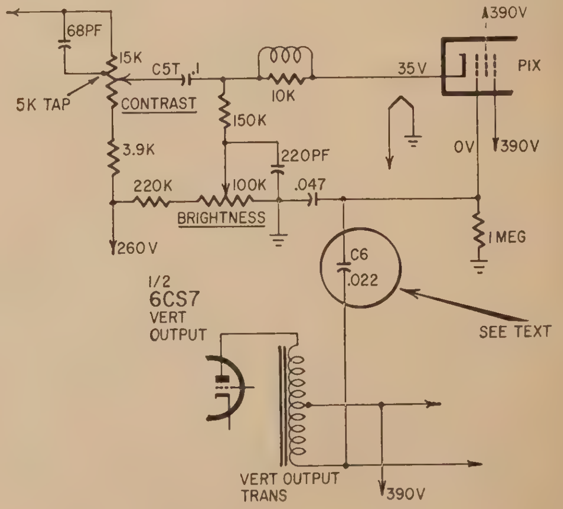

HEIGHT
4.3 MEG
TO CRT PIN 10
390 V
68K 1W
6CS7
VERT OSC & VERT OUTPUT
VERT OUTPUT TRANS
TO VERT INTEGRATOR
100V
6
1
365V
.033
PC
7
3
4
5
YOKE
TO VERT HOLD
8
9
2.2 MEG
10K
390Ω
.008
TO VERT LIN
.005
365V
330V
RETRACE SUPPRESSION
SHORTED
1MEG
3
TO CRT PINS 2&6

You don't have to order a new circuit plate to restore normal operation. Cut away terminal 5 completely. Solder a .008-μf 600-volt (or higher) capacitor to No. 1, and substitute one end of a 10,000-ohm ½-watt resistor for pin 5. Connect the free ends of these two parts together, running one around each side of the circuit plate.—*Roberto Abrego*

PHILCO 7L40

Complaint: Brightness control has no effect.

Video output was normal. C5T and brightness control resistance were all right. But the CRT cathode measured 390 volts instead of 35, and the No. 1 grid showed 390


390V
68PF
15K
C5T
.1
PIX
35V
5K TAP
CONTRAST
10K
150K
3.9K
220PF
0V
390V
220K
100K
.047
BRIGHTNESS
1MEG
260V
C6
.022
1/2 6CS7 VERT OUTPUT
SEE TEXT
VERT OUTPUT TRANS
390V

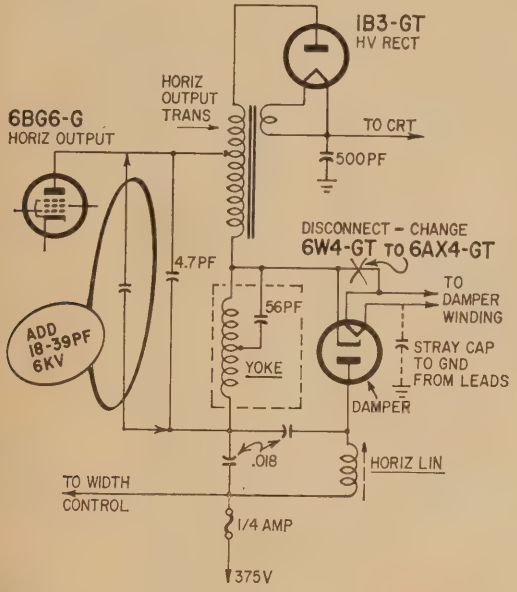
instead of zero.

The trouble was caused by a shorted C6 (circled on schematic below). Replacing it (with a 600-volt unit) cleared the trouble.—*Tom Horiuchi*

RCA KCS-49A: INSUFFICIENT WIDTH

The picture was narrow by about 3 inches on each side, and the trouble was due to stray capacitance from the damper-tube heater lead to ground, as well as in the transformer. This bypassed to ground some of the energy that should have gone to the yoke. The overall efficiency of the sweep system had deteriorated.

Here's what we did. We disconnected the wire from heater to cathode of the 6W4-GT, thus isolating the stray capacitance. The 6W4-GT was changed to a 6AX4-GT to forestall heater-to-cathode arcing.

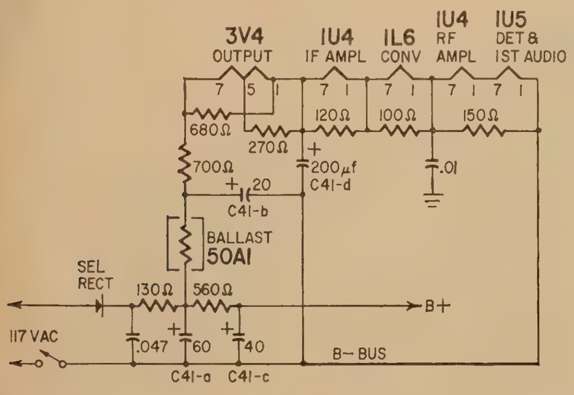


Adding about 39 pf (at 6 kv) across the flyback and yoke windings as shown in the diagram decreased high voltage somewhat and increased the width. Use the smallest possible capacitor for this job.

Also see page 38 of the June 1959 issue of RADIO-ELECTRONICS for more on this subject.—*Warren Dere*

ZENITH T600 PORTABLE RADIO

In this set, the 1L6 converter tube failed too often. It lit up like a Christmas tree every time the set was turned on.



Strangely, removing all the rest of the tubes did not change the situation—even though this is a series filament string.

Turned out finally that poor filter capacitors let high ac ripple pass through the string. A new four-section capacitor (C41) solved the problem.—*Tom Horiuchi* END

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction, servicing, basic Hi-Fi and TV repairs, code, FCC amateur license requirements.

You will learn how to identify radio symbols, how to read and interpret schematics, how to mount and lay out radio parts, how to wire and solder, how to operate electronic equipment, how to build radios. Today it is no longer necessary to spend hundreds of dollars for a radio course. You will receive a basic education in radio, worth many times the small price you pay, only $26.95 complete.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The "Edu-Kit" has been used successfully by young and old in all parts of the world, by many Radio Schools and Clubs in this country and abroad. It is used for training and rehabilitation of Armed Forces Personnel and Veterans throughout the world.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. Every step is carefully explained. You cannot make a mistake.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore, you will construct radio circuits, perform jobs and conduct experiments to illustrate the principles which you learn.

You begin by examining the various radio parts included in the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set, you will enjoy listening to regular broadcast stations, learn theory, practice testing and troubleshooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are 20 Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector, Square Wave Generator and Amplifier circuits. These are not unprofessional "bread board" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

In order to provide a thorough, well-integrated and easily-learned radio course, the "Edu-Kit" includes practical work as well as theory; troubleshooting in addition to construction; training for all, whether your purpose in learning radio be for hobby, business or job; progressively-arranged material, ranging from simple circuits to well-advanced topics in Hi-Fi and TV. Your studies will be further aided by Quiz materials and our well-known FREE Consultation Service.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hookup wire, solder, selenium rectifiers, volume controls, switches, knobs, etc

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to the F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, and a High Fidelity Guide and Quiz Book. Everything is yours to keep.

J. Statatis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

UNCONDITIONAL MONEY-BACK GUARANTEE

The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, schools and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

By popular demand the Progressive Radio "Edu-Kit" is now available in Spanish as well as English.

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc., for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

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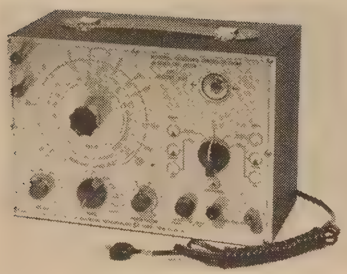
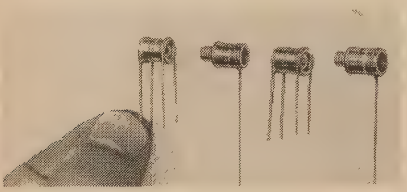


R-C BRIDGE AND IN-CIRCUIT CAPACITOR CHECKER

Model 801, combines functions of two instruments in checking capacitors. Comparator bridge measures resistance from 0.5 ohm to 500 megohms and capacitance from 10 pf to 5,000 μf in 4 ranges. In-circuit tests: detection of open capacitors for any value above 50 pf, with shunt resistance as low as 30 ohms for 350 pf; short detection on all nonelectrolytic capacitors with shunt resistance as low as 100 ohms; and indication of intermittents. R, L and C ratio measurements from .05 to 20, or 400 to 1. 1629 tube provides sensitive indication on all tests. Kit or wired and tested.—**Electronic Measurements Corp.,** 625 Broadway, New York 12, N. Y.

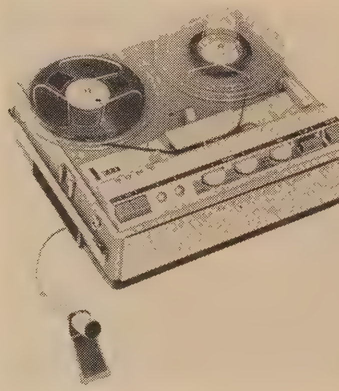


CAPACITORS

Series VC900. A group of 4 subminiature glass piston trimmer capacitors with wide capacitance ranges of 1.2 to 16.0 pf and 1.0 to 10.0 pf. *Series VC900* contains telescopic adjustment mechanism with 500-cycle adjustment life, over 600% greater than requirements of Mil-C-14409B. Shown: *VC960* with standard glass dielectric for printed circuits; *VC950* with standard glass for panel mounting; *VC961* with JFD green glass for printed circuits; *VC951* with green glass for panel mounting.—**Components Div., JFD Electronics Corp.,** 1462 62 St., Brooklyn, N.Y. 11219

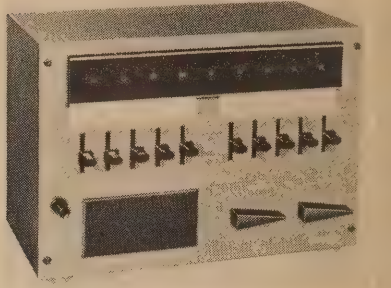
STEREO RECORDER

Sony model 464-SL is a stereo and mono record and playback tape recorder designed as a deluxe teaching instrument, featuring stereo record amplifiers, built-in mono power amp and speaker, student/teacher comparison switch and stereo line outputs for connection to external playback amplifiers. Power: 65 watts, 110-117 vac, 60 cycle; tape speeds: 7½ and 3¾ ips; frequency response: 40-15,000 at 7½ ips; signal to noise ratio: 45 db; flutter and wow: less than 0.19% at 7½ ips; inputs: 2 microphone and 2 high-level line; outputs: 2 high-level line. Comes with two-tone molded carrying case and one Sony *F-96* dynamic microphone.—**Superscope, Inc.,** 8150 Vineland Ave., Sun Valley, Calif.



SPEAKERS

OP-6 and *OP-8.* Integral close-coupled inner horn and diaphragm eliminate conventional phasing plugs, insure impedance match to outer bell. Outer bell has true exponential flair to reduce distortion. Magnetic structure has heavy Alnico V center-pole magnets and heat sink to protect the units' high power-handling capacity. ¼-inch wall sections of *Implex A,* a high-impact material impervious to weather, eliminate sympathetic vibrations. Standard stock units with built-in 70- or 25-volt constant voltage transformers with 45-ohm tap.—**Oxford Transducer Corp.,** 2331 N. Washtenaw Ave., Chicago 47, Ill.

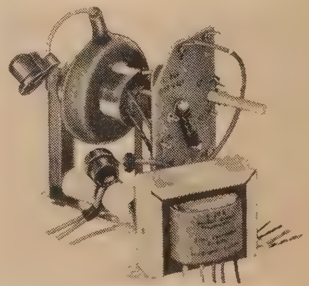


PACKAGED SOUND INSTALLATION

Powrcom series master switching and control consolette adds talk-back and intercom facilities to paging and background music systems; permits independent music and paging in selected areas simultaneously. Also for selective monitoring and surveillance as in factories, garages, shopping centers, etc. *MPC-10* 10-station master consolette (illustrated): optional switch bank expands it to 20 stations; *RPS-1* remote station for low-level paging, talk-back and call origination; *SWB-1* switchbox originates calls for any loudspeaker in system; *Trim Panel G* for mounting MPC-10 into standard 19-inch rack; *JB-14* junction box for interconnection between consolette and speaker lines —**Commercial Sound Div., Harman-Kardon,** 55 Ames Court, Plainview, N. Y.

MICROPHONE

Model 8000 is shock-mounted cardioid dynamic microphone specifically designed for home recordist (or for churches, nightclubs, schools and location AM, FM and TV broadcasting). Low-priced, the mike is guaranteed against defects for 5 years. Frequency response is 70–15,000 cycles, and the diaphragm will, it is claimed, retain its original level of performance for the life of the microphone.—**Special Prods. Div., LTV University,** 9500 W. Reno, Oklahoma City, Okla.



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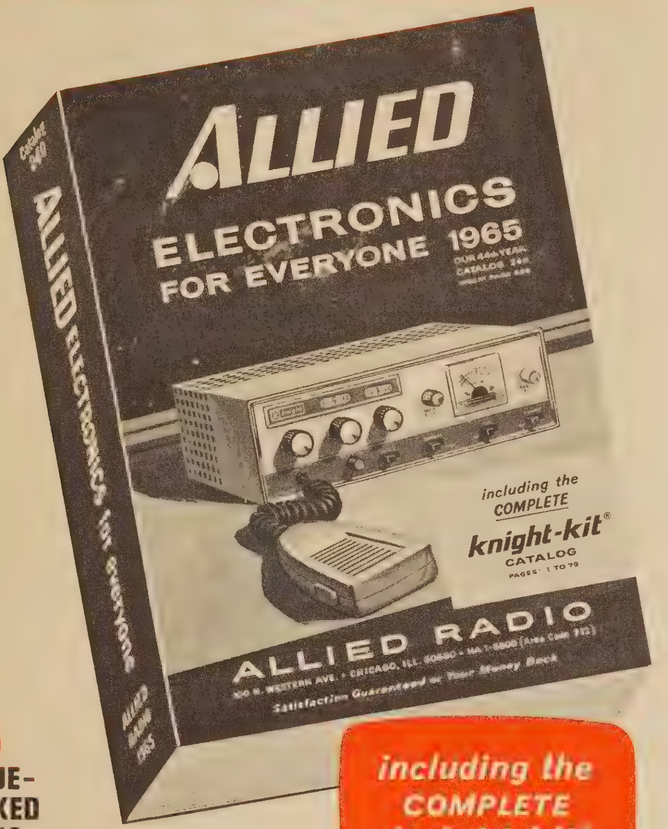
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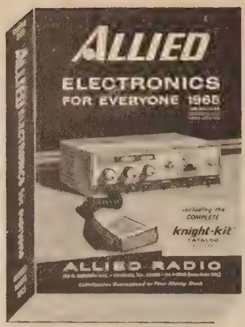
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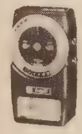

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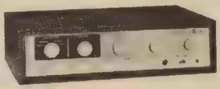

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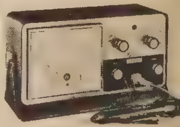

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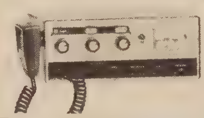

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C-560 Deluxe CB Transceiver with transistorized power supply

See many other outstanding do-it-yourself kits: Hi-Fi, Hobby, Citizens Band, Amateur, Intercom, Test Instrument—wonderfully easy to build—savings up to 50%.

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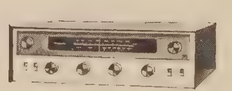

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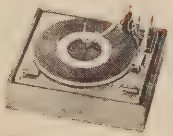
Knight KN-330 Stereo Hi-Fi Receiver—top performance at a new low price



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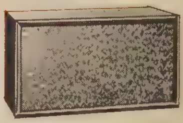
Knight KN-990A Deluxe Hi-Fi Record Changer at tremendous savings



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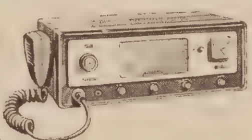
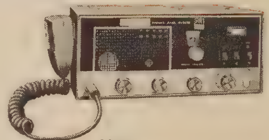


NEW
Knight KN-2565 23 Channel CB Transceiver—a deluxe performer at big savings



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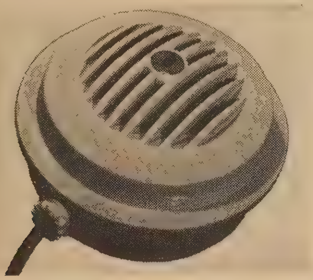
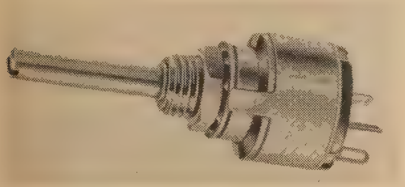
outputs *A-300X* through *A-305X*) were designed for 10 RCA parts numbers, but due to widespread use of basic RCA design can be used as replacements for 17 other brands.—**Triad Distributor Div. of Litton Industries**, 305 N. Bryant St., Huntington, Ind.



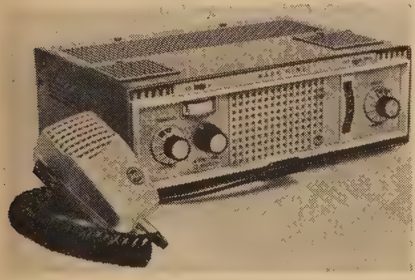
UNDERWATER SPEAKER

Model MM-2PPS, with hermetically sealed components and Polypropylene plastic housing, is designed to make flush mounting installation in existing light niches a snap. With a frequency response of 100 to 10,000 cycles and power capacity of 30 watts, one MM-2PPS will distribute sound through a pool up to 30 x 30 feet.—**LTV University**, 9500 W. Reno, Oklahoma City, Okla.



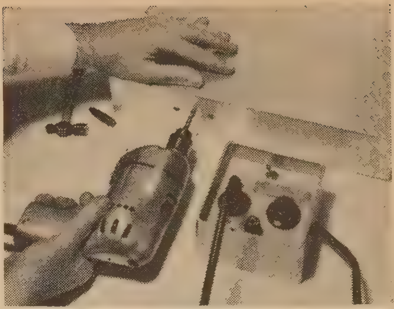
POTENTIOMETER

Series 63M, is of the hot-molded carbon type, is rated at 0.5 watts and measures ½ in. in diameter. Its fused and polymerized base incorporates the carbon resistance element, terminals and base structure as well as the carrier contact in a high-dielectric-strength assembly. The carrier is fitted into a plastic disc; the rotational stop is all metal. Meets all applicable military specifications.—**Clarostat Mfg. Co., Inc.**, Dover, N. H.



CB RADIO

Mark Nine is a 27-megacycle unit designed low and slim (3½ x 11¼ x 3 in.) so that it can be installed under the dash. A combination meter indicates the strength of transmitted and incoming signals. A spotting switch allows precise manual tuning of the receiver without the use of receiver crystals, and permits the user to spot the proper crystal-controlled transmit frequency to respond to an incoming call. Operates on 115-volt ac power supply. Accessory 6- and 12-volt dc supply for mobile operations is optional. Weight including mike is 9 lb.—**RCA Electronic Components & Devices**, Harrison, N. J.



PLUG-IN MOTOR SPEED CONTROL

A new series being marketed through electronic parts distributors, *Speedial* controls are designed for universal (ac-dc) and series dc motors, are also suitable for use on electrical clutches and brakes requiring 0–90 volts dc. Available with ratings of 5 amps, 120 volts ac input to 15 amps, 240 volts ac input, in aluminum housings of 4½ x 4½ x 2⅝ in. A 3-position switch permits selection of variable control, full voltage (direct connection to the line voltage) and off positions.—**International Resistance Co.**, 414 N. 13 St., Philadelphia, Pa. 19108

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The *Gemini* combines an automatic rotator with a transistorized booster and 2-set coupler so that only one transmission line is required; 80 feet of low-loss 4-conductor line in included. There are 2 versions of the *Gemini: model 9518* for TV and FM; *model 9527* for TV only. 90-day instant-replacement guarantee.—**Channel Master Corp.**, Ellenville, N. Y.

FINE-POINT SOLDERING TIP

Wen model 75 soldering pistol. Tip temperature of 100–130 watt device from peak surge rating of 50 watts and normal draw of 30 watts. 3-inch tip assembly steps down for 3/16- to 1/8-in. diameter, tapering to fine point.—**Wen Products, Inc.**, 5810 Northwest Highway, Chicago, Ill. 60631

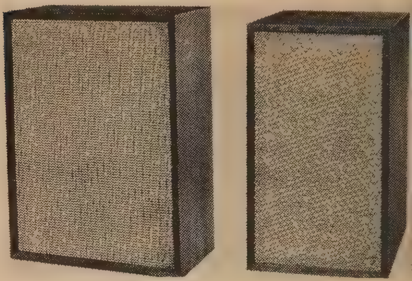
TUBE TESTER

Model 580 permits setting test conditions directly from a tube handbook without reference to the roll chart; has transistorized gas test circuit for measurement of gas down to .05 μa. Four conductance ranges to 60,000 μmhos. Leakage can be read directly on the meter, sensitive to 50 megohms. There is a pushbutton test of dual tubes; plate, grid and cathode jacks for access to these elements under test conditions; illuminated meter and roll chart.—**Hickok Electrical Instrument Co.**, 10514 Dupont Ave., Cleveland 8, Ohio

THE Hi-Gainer

CLIPPER/COMPRESSOR/SPEECH AMPLIFIER

The *"Hi-Gainer"* is designed to give an extra audio punch to CB, ham and commercial radio telephone transmitters, and is completely self-powered by a 9-volt battery. It allows 100% modulation with normal speech, and may be used mobile or base.—**Control Products**, 123 Ave. U, Brooklyn 23, N. Y.



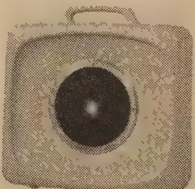
TWO SPEAKER SYSTEMS

The *Beverly Hills* (*model SE-880*) and the *Scarsdale* (*model SE-80*), the first an enclosure with two 8-inch speakers and the second with single 8-inch speaker, are constructed of ¾-in. nonresonant panels finished in hand-rubbed oiled walnut veneer, each joint being lock-mitered. Both enclosures are vented. *Model SE-880:* response 45–20,000 cycles; power 40 watts; average programming 80 watts peak; impedance 8 to 16 ohms. *Model SE-80:* response 45 to 20,000 cycles; power rating 20 watts; average programming 40 watts peak; impedance 8 ohms.—**Sonotone Corp.**, Elmsford, N. Y.

PORTABLE TV INVERTER

The *12TV12*, powers portable TV sets from a 12-volt battery in automotive and marine equipment, house trailers, campers, etc. It has a special switch tap for radio receivers, dictating machines, phonographs, shavers or other transformer-operated equipment with a 75% to 100% power factor not requiring more than 120 volts.—**Cornell-Dubilier Electronics Div.**, 50 Paris St., Newark 1, N. J.

PORTABLE LOUDSPEAKER



Sonocaster, 8 lbs., plastic housing. 8-in. coaxial driver unit for outdoor/indoor hi-fi use. Ceramic magnet assembly, double-wound voice coil. Response, 70–13,000 cycles; nominal dispersion, 120°; power capacity, 30 watts peak; impedance, 8 ohms; crossover, 3,500 cycles. 16¾ x 17 x 5⅞ in.—**Electro-Voice, Inc.**, Buchanan, Mich.

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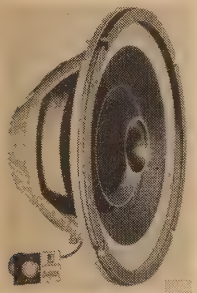
literature. Spring-suspension permits cartridge to pivot when sudden force is applied, brings stylus off record surface and places soft "sole" on surface. Mounts in any arm with standard ½ or 7/16-in. mounting centers. *149DF* tracks at 2-4 grams; *150DF* at 4-6 grams.—**Electro-Voice, Inc.**, Buchanan, Mich.

HI-FI LOUDSPEAKERS



Delta series. Model DL-220: 3-element, 12-in. coaxial unit. *DL-120:* dual-cone, 12-in. speaker. *DL-80:* dual-cone, 8-in. speaker. Each has Syntox magnetic systems; Flexair suspensions; binding-post terminals; die-cast housings; stable spider suspensions for positive voice-coil centering; power capacity 20 watts.—**Jensen Manufacturing Co.**, 6601 S. Laramie Ave., Chicago, Ill. 60638

FM STEREO TUNER/AMPLIFIER

Model 345. 3 new circuits: low-impedance symmetrical output drive; series-gate time-switching multiplex for good stereo separation and presence; pulse-suppression limiting for minimum interference. 64 watts of audio. Front-panel earphone jack. Stereo indicator shows when stereo is being received. Preamp tubes have dc on heaters.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

MAGNIFYING GLASS

Premium with purchase of 12 *Vu-Brites*, either *C-401* parallel or *C-402* series brighteners. 2-in. diameter glass folds in leatherette case.—**Perma-Power Co.**, 5740 N. Tripp Ave., Chicago, Ill. 60646

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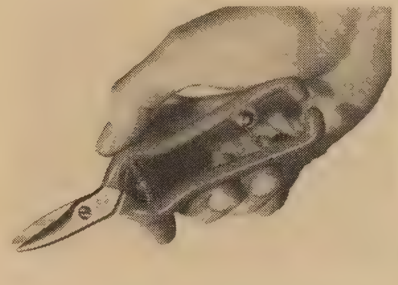
No. 86 fine wire and filament cutters. High-carbon drop-forged tool steel. For removing insulating coverings and cutting sheet metals up to .025 in. thick. Thumb-operated latch keeps snips closed, coil spring returns blades to open position. Chrome-plated blades, plastic-coated handles. 6½ in. long, length of cut 1¼ in.—**Xcelite Inc.**, Orchard Park, N. Y.



CAPACITOR CHECKER

Model TO-6 Tel-Ohmike. Low ac bridge voltage for checking low-voltage electrolytics and ceramics in transistorized circuits. Measures 0 to 2,000 μf in 5 overlapping ranges, insulation resistance to 50,000 megohms, power factor to 50%, leakage current in 4 ranges from 0 to 60 ma. Burnout-proof meter, safety discharge switch, 3-wire line cord. Charcoal-gray panel.—**Sprague Electric Co.**, North Adams, Mass.

TRANSISTORIZED BATTERY CHARGER

Model BC2. Charges 6–12-volt batteries at up to 6 amps. Current drops as battery reaches full charge; automatic-reset circuit breaker prevents damage to charger or battery. Aluminum case, 3½ x 4½ x 5 in. 6½-ft. lead wires, 6-ft. ac cord, ammeter.—**Workman Electronic Products, Inc.**, Box 5397, Sarasota, Fla.; END

All specifications from manufacturers' data.

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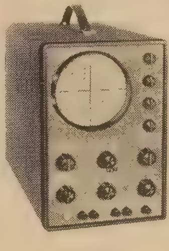
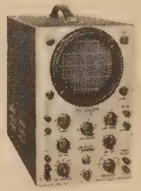
5-INCH

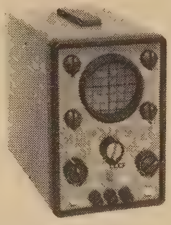


EICO 427 ADVANCED GENERAL PURPOSE 5" SCOPE High sensitivity scope has all the facilities and quality demanded for servicing audio, communications and industrial equipment. Vert. amp. flat from DC to 500 kc, —6 db at 1 mc; 3.5 mv rms/cm sensitivity. Horiz. amp. flat from 2 cps to 450 kc; 0.18 v rms/cm sensitivity. Automatic sync. Sweeps from 10 cps to 100 kc. Kit **$69.95;** Wired **$109.95.**

EICO 460 WIDEBAND 5" SCOPE For color & black-and-white TV servicing. Easily reproduces 3.58 mc color TV synchronizing burst. Vert. amp. flat from DC to 4.5 mc, usable to 10 mc; 25 mv rms/inch sensitivity. Horiz. amp. flat from 1 cps to 400 kc; 0.6 v rms/inch sensitivity. Automatic sync. Sweeps from below 10 cps to 100 kc. Kit **$89.95;** Wired **$129.50.**

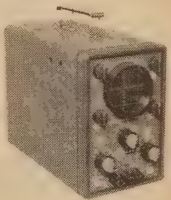


3-INCH



EICO 430 PORTABLE GENERAL PURPOSE 3" SCOPE Remarkably fine compact scope. Excellent for servicing audio, communications, and industrial equipment. Ideal as a ham shack monitor. Flat-face 3" CRT with mu metal shield eliminates affects of external fields. Vert. amp. flat from 2 cps to 500 kc, —6 db at 1 mc; 25 mv rms/cm sensitivity. Horiz. amp. from 2 cps to 350 kc, 0.25 v rms/cm sensitivity. Sweeps from 10 cps to 100 kc. Kit **$69.95;** Wired **$99.95.**

PLUS—the new 435 wide band 3-inch scope. All the features of the 460 in a 3-inch compact portable. Ideal for color TV and industrial servicing, and testing. Weighs only 15 lbs. Kit **$99.95;** Wired **$149.95.**



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Winegard engineers have used two of the new 6HA5 ampliframe shielded triode tubes and new circuitry to create the all new Winegard Booster coupler that dramatically increases signal power & cuts noise to a minimum. This increased power means 8 DB gain to each of 4 outputs, reducing snow, picture smear and interaction between sets.

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CAPSULE THERMISTOR COURSE *No. 7*, single loose-leaf page, "Thermistors—How They Compare with Thermocouples, Resistance Thermometers." Resistance-temperature graph collates resistance change of thermistors with platinum. Table shows output voltage change with temperature for thermistors, platinum resistance bulbs, and thermocouples.—**Fenwal Electronics, Inc.,** Sales Engineering Dept., 63 Fountain St., Framingham, Mass.

MODULES CATALOG, *SP-173*, 40 pages, 4 colors, lists 90 germanium digital modules with specs, logic and circuit diagrams, other details on 200-kc, 1-mc and 5-mc circuits.—**Packard Bell Electronics,** Computer Div., 2700 S. Fairview St., Santa Ana, Calif.

POWER SUPPLY DATA FILE, 10 application bulletins: *6401*—Protecting the Power Supply and its Load from Each Other, Part I. *6402*—How Far—The Custom/Power Range of Sizes and Types Defined—At Last! *6403*—The Primary Bridge and Primary Clipper Regulators—Two New Approaches. *6404*—How to Check Your Power Supply Specification for Validity. *6405*—Programming Power Supplies—Analog and Digital Techniques. *6406*—Solid-State Power Supplies: Types and Techniques. *6407*—Low Dissipation Regulators and Protective Circuits. *6408*—DC Reference Supplies—Current and Voltage. *6409*—How Big? How Heavy? How Efficient? How Hot? How Much? *6410*—Case Histories—All of Them with Happy Endings. Available free to qualified engineers and designers. Will be supplemented periodically.—**Trio Labs Inc., Custom/Power Div.,** Dupont Dr., Plainview, N.Y.

CB CATALOG SHEETS, announcing two new transceiver models, *Escort* and *Companion II*. 2 pages on each detailing general, transmitter and receiver features.—**Pearce-Simpson, Inc.,** 2295 N.W. 14 St., Miami 35, Fla.

WHOLESALE DISTRIBUTORS CATALOG, 280 pages. Illustrated, with descriptions of complete line of distributor's stock, at OEM (original equipment manufacturer) prices, including semiconductors, tubes, capacitors, resistors, transformers, switches, relays, fuses, terminals, connectors, CB equipment, cabinets, etc.—**Klaus Radio & Electric Co.,** 403 E. Lake St., Peoria, Ill. 61614

STEREO TAPE RECORDER, *model TX10*. 4-page, 2-color brochure with photos and specs on portable/studio model, e.g. 55 db signal-to-noise ratio, 1% total harmonic distortion, 3 heads (erase, record, playback), hysteresis synchronous motor, horizontal or vertical operation, 3- to 10½-inch reels, 2 high-level inputs and 2 mike inputs, 3 output jacks. Also information on accessories, portable amplifiers.—**Newcomb Audio Products Co.,** 6824 Lexington Ave., Hollywood 38, Calif.

ZENER DIODES CATALOG, *Bulletin 122-264*, 20 pages, lists and describes nearly 500 Zener diode types and variations from micro diodes through ½-watt and 1-watt to 10-watt types. Characteristics of MIL-E-1900 types, ultra-stable temperature-compensated reference elements, temperature-compensated glass Zeners and low-voltage forward regulators. Curves and dimensions, loose-leaf punched.—**TRW Semiconductors Inc.,** 14520 Aviation Blvd., Lawndale, Calif.

COPPER OXIDE INSTRUMENT RECTIFIERS, Series 80 (with photo) and Series 160-U (with diagram). Full specifications given on one loose page each.—**Conant Laboratories,** 6500 "O" St., Lincoln, Neb. 68505

PUBLICATIONS BULLETIN, *1964*, describes in 4 pages two new radio and TV manuals, plus earlier manuals, and includes 1 page of hints on how to use radio-TV data.—**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

KIT CATALOG, *May 1964*, 48 pages, 2 colors, photos of kits after assembly. Color TV, organs, CB, ham and short-wave radios, intercoms, garage-door opener, computer system, marine accessories (antennas, deck speakers, vapor detector, depth sounder, rudder indicator, ground system, tachometer), test instruments, hobby tools, amplifiers, cartridges, headphones, record changers, speakers, tape recorders, tuners and receivers.—**Heath Co.,** Benton Harbor, Mich.

WINDOW POSTER, *series RP-33*, 17 x 22 in., with black-and-white cartoon, headlined "Is 'Do-It-Yourself' TV Service As Dangerous As They Say?", two columns of text and credited at the bottom to "Your Independent TV-Radio Service Dealer."—**Sprague Products Co.,** North Adams, Mass.

WIRE AND CABLE CATALOG, *No. W-4*. 52 pages detail more than 7,000 items from stock including coaxial cable to military specs, control and instrumentation cable, flat ribbon cable, unshielded control cable and UL-approved hookup wire. 2 colors, illustrated.—**Alpha Wire Corp.** 180 Varick St., New York, N.Y. 10014

PUSHBUTTON SWITCH CATALOGS, *L-169A, L-172, L-173, L-176*. 14 pages in all, dealing with momentary-contact type subminiature pushbutton switches and matching indicator lights with characteristics, catalog numbers, dimensions, circuitry, mounting instructions.—**Dialight Corp.,** 60 Stewart Ave., Brooklyn, N.Y. 11237

RELAYS. *Engineering Bulletin 101-64*, 6-page folder in 3 colors with specs, illustrations and mounting data on new line of dry-reed and mercury-wetted contact relays. 40 stock part numbers including printed-circuit and octal plug-in units. —**Magnecraft Electric Co.,** 5581B N. Lynch Ave., Chicago, Ill. 60630

CATALOG ADDITION to Trimpot catalog, *Bulletin MC/C/O*, 4 pages on discrete microcomponents meeting military specs; resistors, capacitors, inductors, transformers, with specs, curves, characteristics.—**Bourns, Inc.,** Trimpot Div., 1200 Columbia Ave., Riverside, Calif.

GENERAL CATALOG AND REPLACEMENT GUIDE *No. 164*, 136 pages, photos, price

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GLASS CAPACITORS. *Booklet 93-160,* 4 pages, looseleaf punched. Describes CYW type capacitors. Graphs of operating-range capacitance, insulation resistance, dissipation factor, Q. Cross-indexed for Mil specs.—**Westinghouse Electronic Capacitor Dept.,** Irwin, Pa.

TIN OXIDE RESISTORS BULLETINS, 4 single looseleaf sheets. *CE-2.10* describes LPI-2 (2-watt) and LPI-10 (10-watt) low-power units; *CE-2.21* is on NA-style precision resistors; *CE-2.31* describes HNR-style resistors which show failure rate of .00057% per 1,000 hr.; *CE-2.32,* HRL-style, failure rate .015% per 1,000 hr. Photos, curves, specs, applications—**Corning Glass Works,** Electronic Prods. Div., Raleigh, N.C.

REPLACEMENT AND INTERCHANGEABILITY GUIDE for transistors and diodes, 3½ x 5 in., 20 pages, pocket edition of manufacturer's **Transistor & Diode Replacement Interchangeability Chart** (wall). Lists 3,000 transistor and diodes and 40 Semitron units that replace them.—**Semitronics Corp.,** 265 Canal St., New York, N.Y. 10013

STEREO TAPES CATALOG, May 1964, 28 pages, 3½ x 8½ in. Monthly service; contains all new releases from United Stereo Tapes.—**Ampex Corp.,** Consumer & Educational Products Div., 2201 Landmeier Rd., Elk Grove Village, Ill.

FOUR-LAYER DIODE BULLETIN, *C-101,* looseleaf-punched single sheet; photos, curves and specs of silicon diodes 1N3831 and 1N3846.—**National Transistor,** subsidiary of ITT, 500 Broadway, Lawrence, Mass.

ANTENNA REFERENCE INDEX, 18 antenna types described in 16-page, 2-color booklet. Lists patterns, radiation impedances, gain, other performance characteristics of 18 basic types including phased arrays.—**Sylvania Electric Products Inc.,** Dept. M-P, 100 1st Ave., Waltham 54, Mass.

PRECISION FILM RESISTORS CATALOG, 6 pages, looseleaf, foldout, 2 colors; complete specs on 8 types of metal film resistors and 16 deposited carbon types.—**Campbell Industries,** Div. of Clarostat Mfg. Co., Inc., Dover, N.H.

FILTER CATALOG, *No. C-100,* 2 colors, 32 pages; photos, drawings, curves, specs covering line of low-pass, bandpass, tunable bandpass filters, SWR-measuring devices, tunable frequency multipliers, power dividers, impedance transformers. Special model numbering system in each product group.—**Telonic Engineering Co.,** Marketing Dept., 480 Mermaid St., Laguna Beach, Calif.

1964 MASTER INDEX lists every television and radio set included in "Most-Often-Needed Servicing" manuals (18 TV manuals, 24 radio volumes). To find volume and page of material, look up under name of set. 42 pages. Usually 25¢; **10¢** to RADIO-ELECTRONICS readers.—**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

CERAMIC FIXED CAPACITORS, *Bulletin UNM 64-1,* 12 pages, looseleaf; photos, curves, specs on Uniceram High-Q and High-K types, plus description of sampling kit USK-63.—**JFD Electronics Corp.,** 15th Ave. at 62 St., Brooklyn, N.Y. 11219

KIT CATALOG, *1964 "Edu-Kit".* 50-page booklet includes wired as well as kit instruments, components, transistors, hi-fi, ham, photo kits. Also books and courses.—**Progressive "Edu-Kits" Inc.,** Dept. R-E, 1186 Broadway, Hewlett, N.Y.

> Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.
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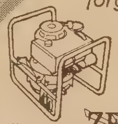

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technicians' News

FTC-DELAWARE VALLEY CASE AROUSES INTEREST

The Federal Trade Commission's charges against the TV Service Association of Delaware Valley (reported in August RADIO-ELECTRONICS, page 82) have stirred ripples in the industry. The *Audio Times*, a New York trade paper, disagrees firmly with TSADV's harsh boycotting of "dual-distributing" wholesalers, yet "believes that the action taken by the FTC against the *TSA News* [TSADV's monthly publication] is a blow against a free press. . . . If the FTC can make its charges stick against the publication . . . the result will be to intimidate other trade editors—to prevent them from speaking out on issues of importance . . ."

The editorial went on to say that at last the FTC would have to face squarely the issue of dual distribution. That issue arises whenever a wholesale supplier of appliances or parts or accessories begins to advertise and sell to the general public as well as to his trade clients, thus putting himself into competition with the small dealers who depend on him. Because he can sell to the public at a lower price than a dealer, he has an unfair competitive price advantage over the dealers who buy from him and have to make their profit also.

Some actions that the FTC cites in the charges against the TSADV date back 5 years. Specifically, the FTC charges, the TSADV:

Communicated to [offending] wholesale distributors threats of concerted withdrawal of patronage.

Combined to boycott these wholesale distributors to coerce them to discontinue selling equipment or parts at retail in competition with individuals or organizations engaged in servicing and repair.

Dictated or attempted to dictate practices to be followed by wholesalers in the conduct of their business involving such matters as hours, display windows and advertising.

Published "white lists" of dealers who cooperated in refusing to sell at retail.

Used paid shoppers to check on distributors.

Generally, the FTC held, those practices impeded competition and deprived the public of the choice of vendors to which they are entitled.

TRI-STATE COUNCIL TECHNICAL PROGRAM VOTED IN AT "TELERAMA"; OFFICERS ELECTED

"Telerama '64", organized by the Tri-State Council of TV Service Associations, a group comprising Delaware, Pennsylvania and New Jersey service associations, was pronounced a great success by Tony De Franco, editor of the group's publication *The Vanguard* and newly elected president of the organization.

Held in Atlantic City, N. J., June 19–22, the annual convention gave member technicians an opportunity to meet, discuss the industry and investigate new equipment. Tops on the business agenda was discussion and approval of what is described as "one of the most ambitious technical and business training programs ever conceived for the benefit of the television service technician."

As part of that program, Tri-State Council will have available for its affiliated associations four (different-make) 1965 color TV sets, one for each association, and a collection of the most modern test, service and alignment equipment (color bar generators, sweep and marker generators, circuit analyzers and

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CRT testers. All this is to be supplied in rotation to the member groups.

Technical meetings will be scheduled to demonstrate the equipment and explain how to use it. Each association will rotate the equipment among its members and, at the end of 3 months, another make of color set will be made available, until every member has had experience with each of the four sets and all of the equipment.

Similar programs are planned for transistor TV sets, hi-fi–stereo equipment, tape recorders and other home-entertainment devices the technician is called on to service.

Lectures and demonstrations on business management have also been scheduled.

The Tri-State Council elected officers during the Telerama convention. Tony De Franco became president; Peter Rapagnani was re-elected vice president. The new secretary is Joseph Papovich, and Ray Dellinger continues as treasurer.

EIA BEGINS "ADDITIONAL SERVICE" PROGRAM

The Electronic Industries Association's Distributor Products Div. will launch a regional test of a proposed national program to stimulate sales of electronic replacement parts through service dealers by encouraging them to ask customers, "What else needs fixing?"

Norman A. Triplett, executive vice president in charge of marketing for Triplett Electrical Instrument Co. and chairman of the EIA program, said materials will be developed to educate dealers in the "additional service" approach. Many homes contain second radios, TV's or phonographs not in working order which could be repaired if the customer were reminded of them.

Triplett said the program will be patterned after a successful one conducted by the petroleum industry, under which service-station dealers pushed sales of gas, oil and parts by asking, "Fill 'er up?" or "Check your oil?"

At this writing, the region for the test program has not been selected.

PHILCO GETS NATESA AWARD

For the second consecutive year, Philco Corp has been presented the "Friends of Service" award by the National Alliance of Television & Radio Service Associations. Philco was cited for its continuing cooperation with the independent dealer and technician.

Alex Tagnon, field service manager at Philco, accepted the award plaque on behalf of Philco's Parts and Service Operation from William Childs, NATESA's West Central vice president, at the association's Spring Directors Conference in Memphis, Tenn. END

BUILD this new portable MOOG Hi-Fi Amplifier Speaker

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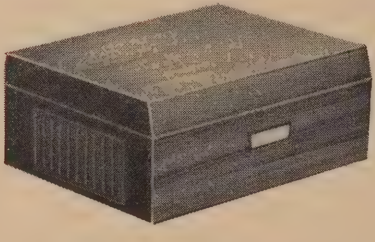

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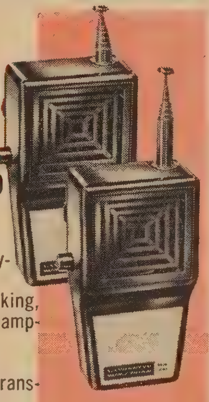

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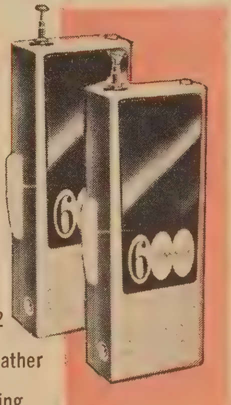

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WITH ADVANCED "RANGE-BOOST" CIRCUIT

Efficient, dependable 2-way communications in any fixed or mobile application is assured with this rugged, new 5-watt CB transceiver. A military-type frequency synthesizing circuit makes it possible to transmit and receive over the full range of 23 channels with crystal-controlled accuracy—no extra crystals to buy and install! Advanced Range-Boost circuit can be used to increase sideband power during transmission—lets you get through when noisy conditions make reception of your signal difficult!

Highly efficient circuit design uses 13 tubes (including two nuvistors) and 8 diodes to provide top performance under a wide range of operating conditions. Dual-conversion receiver offers high .3 μv sensitivity and low noise, plus excellent adjacent channel rejection. Includes every needed feature for optimum reception—crystal-controlled "fine tuning" capability on all channels of ±2.5 Kc (Delta Tuning), high-efficiency variable noise limiter, variable squelch, and Automatic Volume Control. Also included is an illuminated meter which indicates relative RF power output or received signal strength in "S" units, and plug-in facilities for the Lafayette PRIVA-COM selector call unit.

Operates in a fixed or mobile location with equal ease . . . has built-in power supply for either 117V AC or 12V DC. Specially designed "Vari-Tilt" mounting bracket simplifies mobile installation—permits fast removal of the transceiver too! And, there's nothing else to buy—you get all crystals and a built-in vibrator for 12V DC, plus 2 power cables. Measures a compact 12"Wx5"Hx10"D (including controls and plugs at rear). Imported. Model HB-400.

99-3001WX **169⁵⁰**

Model HB-400

CITIZENS BAND TRANSCEIVER
L
RANGE BOOST
LAFAYETTE

Double Side Band Full Carrier

- ✓ Meets All FCC Requirements
- ✓ Precision-Engineered and Ruggedly Built For Reliable 2-Way Radio Communications

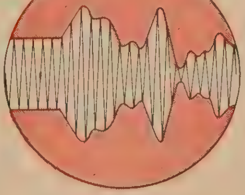
■ *Frequency Synthesized Circuit Provides 23 Crystal-Controlled Transmit & Receive Channels—No Extra Crystals to Buy!* ■ *Continuous One-Control Channel Tuning* ■ *Full 5-Watt Input* ■ *Push-To-Talk Microphone & Electronic Switching* ■ *Dual Conversion Receiver With 3/10 μv Sensitivity* ■ *Delta Tuning Offers "Fine Tuning" of ±2.5Kc on Receive* ■ *Variable Squelch, Variable Noise Limiter, AGC* ■ *Built-in 117V AC & 12V DC Power Supply* ■ *"Vari-Tilt" Mounting Bracket for Easy Mobile Installation* ■ *Plug-in Facilities For Lafayette Selective Call Unit*

ADVANCED "RANGE-BOOST" CIRCUIT

Increases Your Effective Range—Lets You Get Through When Others Fail!

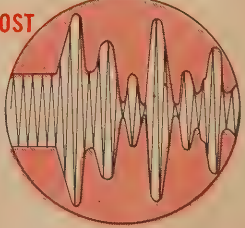
Want to effectively increase your range? You can—with Range-Boost! A simple turn of a switch on the HB-400 increases the average percentage of modulation and lets your voice cut through QRM and noise to reach further . . . gives you more "talk-power" when you need it—without overmodulating!

CONVENTIONAL



Average Percentage of Modulation Is Lower

WITH RANGE-BOOST



Average Percentage of Modulation is Higher—Sideband Power is Increased

NEW! LAFAYETTE ALL-TRANSISTOR DUAL CONVERSION 5 WATT CB TRANSCEIVER

FEATURING AUTHENTIC MECHANICAL FILTER

Model HB-500

LAFAYETTE
CB
METER
VOLUME
SQUELCH
A
CHANNEL
12
TUNER
LAFAYETTE

Small, Compact . . . Measures Only 11$\frac{7}{16}$"Wx6$\frac{11}{16}$"Dx3"H.
Low Current Drain . . . 350 ma on Receive, 850 ma on Transmit.

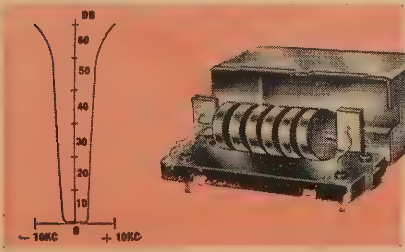
■ 12 Crystal Transmit Positions plus 12 Crystal Receive Positions ■ 23 Channel Tunable Receiver with Precise Vernier Tuning ■ Dual Conversion Super-heterodyne Receiver ■ 15 Transistors, 3 Diodes, 1 Zener Diode plus 1 Thermistor ■ Zener Diode Voltage Regulated Receive Oscillator for Superior Frequency Stability ■ Dependable Sealed Relay Switching ■ Automatic Noise Limiter ■ Variable Squelch ■ For 12 Volt DC Mobile Operation (Negative or Positive Ground) or for 117V AC Operation when used with Matching Solid State AC Power Supply (Optional) ■ Meets All FCC Regulations Part 95

If you're looking for a high-performance CB transceiver in a small, compact size, you'll want the HB-500! Using advanced solid-state circuitry, this transceiver offers full 5-watt performance, yet is small enough to fit conveniently into the most compact car. And, battery drain is so low as to be negligible—the transceiver draws no more than .35 amps on receive, .85 amps on transmit. As a result, you need neither heavy-duty battery nor generator—an important advantage in mobile applications! The transmitter features full crystal control on any 12 of the 23 CB channels. Dual conversion receiver with better than .5 μv sensitivity offers 12 crystal-controlled channels, plus full 23 channel tuning capability. A 455 Kc mechanical filter provides ultra-sharp receiver selectivity—virtually eliminates adjacent channel interference! Other features include an efficient Automatic Noise Limiter, variable Squelch for silencing the receiver on standby, spotting switch for exact frequency location on tunable receiver, "S" meter and illuminated channel dials. This rugged transceiver offers instantaneous, cool-running operation and features printed circuit, all-transistor design. Equipped with mobile mounting bracket, push-to-talk dynamic microphone, crystals for operation on channel 12. Operates on 12V DC (neg. or pos. ground) or on 117V AC with optional solid-state power supply. Imported.

Model HB-500.

139^{50} **99-3027WX**

HIGHLY SELECTIVE MECHANICAL FILTER

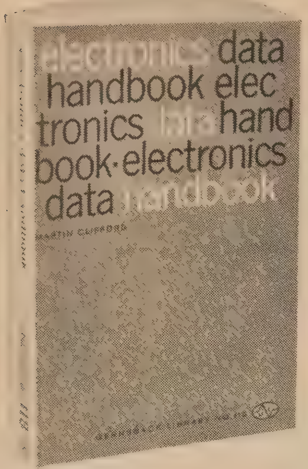


With CB channels only 10 Kc apart, selectivity is important! In the HB-500, ultra-sharp selectivity is achieved by means of a true mechanical bandpass filter in the 455 Kc IF section. At 10 Kc on either side of the center frequency, the filter provides 60 db of attenuation — an extremely high rejection ratio that assures complete adjacent channel rejection!

Model HB-501 Solid State AC Power Supply

Matching solid state AC power supply for HB-500 for fixed station operation (at home, business office). Transceiver rests on power supply to form attractive integrated unit. Size 11$\frac{7}{16}$x6$\frac{11}{16}$x3$\frac{11}{32}$". Imported.

99-3028 .... Net **16.95**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PARTIAL LIST OF CONTENTS

D. C. Resistors in series. Resistors in parallel. Resistors in series-parallel. Conversion of units. Resistance of a copper line. Length of a desired resistance. Calculating wire gauge. Resistance vs. temperature. Forms of Ohm's law. Power. Voltage drops. Bleeders. Bias resistors. Batteries in series. Batteries in parallel. Batteries in series-parallel. Kirchhoff's laws. The voltage law. The current law.

A. C. Wave length. Period. Frequency. Instantaneous current. Instantaneous voltage. Pulsating direct current. Alternating and direct currents combined. Capacitors in series. Capacitors in parallel. Capacitors in series-parallel. Amount of electricity stored in a capacitor. Capacitive reactance. Voltage distribution across capacitors in networks. Inductors. Inductors in series. Inductors in parallel. Mutual inductance. Coupled inductance. Inductors in series, aiding. Inductors in series, opposing. Inductors in parallel, aiding. Inductors in parallel, opposing. Q factor. Coefficient of coupling. Inductive reactance. Impedance. Phase angle. Ohm's law for alternating current. Power factor. True power. Apparent power. Resonance. Numerical magnitude of impedance . . . single resistor, resistors in series, single inductor, inductors in series, single capacitor, capacitors in series, resistance and inductance in series, resistance and capacitance in series, inductance and capacitance in series, resistance, inductance and capacitance in series, resistors in parallel, inductors in parallel, capacitors in parallel, inductance and resistance in parallel, capacitance and resistance in parallel, inductance and capacitance in parallel, inductance, resistance and capacitance in parallel, inductance and series resistance in parallel with capacitance, and capacitance and series resistance in parallel with inductance and series resistance.

VACUUM TUBES Thermionic emission. Amplification factor. Dynamic plate resistance. Mutual conductance (transconductance). Gain of an amplifier stage. Voltage output Determining tube constants. Triode power output. Pentode power output. Maximum power output. Maximum undistorted power output. Plate efficiency. Approximate load resistance. Triode and pentode power sensitivity. Detector efficiency. Negative feedback. Miller effect. Rectifier ripple. Filter formulas Regulation.

TRANSISTORS Emitter resistance. Base resistance. Collector resistance. Current gain. Voltage gain. Power gain. Collector capacitance. Cutoff frequency. Input impedance. Output impedance. Alpha. Beta. Negative resistance. Power dissipation. Power output.

ANTENNAS and TRANSMISSION LINES: Length of a Hertz antenna. Physical length vs. electrical length. Formula for "end" effect. Resonant frequency. Physical height in wavelengths. Antenna current. Antenna power. Characteristic impedance. Transmission line current. Transmission line peak voltage. Transmission line losses. Attenuation. Frequency. Field strength. Capacitance of a vertical antenna.

MEASUREMENTS: D. C. resistance of a milliammeter. Ohms-volt rating of a voltmeter. Ammeter shunts. Multi-range shunts. Voltage multipliers. Wheatstone bridge. Slide-wire bridge. Kelvin bridge. Series and shunt ohmmeters. Measuring resistance with a voltmeter. Measuring inductance with voltmeter and ammeter. Measuring capacitance. Capacitance-resistance bridge. Wien bridge.

TABLES and MISCELLANEOUS DATA Copper wire table. Specific resistance and temperature coefficients. Table of common logarithms. Natural sines and cosines. Natural tangents and cotangents. Table of vector conversions. Conversion factors. Constants. Mathematical symbols. Resistor color code. Capacitor color codes. Dielectric constants. Transformer color codes. I.F. transformer color codes.

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noteworthy Circuits

IMPROVING THE HALF-WAVE SUPPLY

Many electronic devices use a half-wave power supply (Fig. 1-a) consisting of a power transformer and a silicon diode. If hum is an inherent problem, consider converting the circuit to a full-wave bridge type (Fig. 1-b) by adding three more silicon diodes. The ripple voltage is lower and its fundamental frequency is doubled, thus making the filter more effective. Also, the output voltage is slightly higher.—*Charles Erwin Cohn*

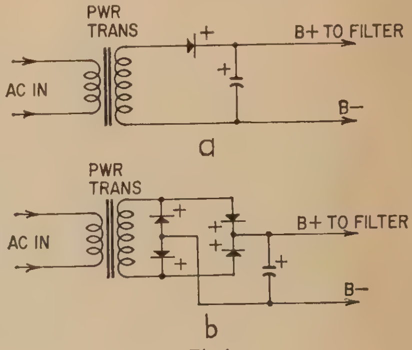
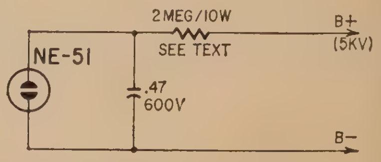


Fig.1

HIGH-VOLTAGE INDICATOR LIGHT

While building a 5-kv transmitter power supply we needed a pilot lamp to indicate whether the filter capacitors were charged. This was necessary for safety as the bleeder resistor took 20 seconds to discharge the filters.

First thought was a neon lamp with a high-value series resistor. This worked fine at high voltages, but below 500 volts the lamp was just barely visible. At 300 volts, it went out.



Finally the circuit shown evolved. At voltages from 5,000 to 500, the 2-megohm resistor acts as a dropping resistor for the neon lamp.; Below 500 volts, the circuit becomes a relaxation oscillator, and the lamp blinks brightly. The circuit gives a good indication of voltage from 5,000 to about 65. When this voltage is reached, further discharge of the filter capacitors is very quick. The 2-megohm 10-watt resistor is a special high-voltage type manufactured by International Resistance Co. and called the MVP-17. This resistor is made on special order for around $2.80 to $5, depending on tolerance. IRC has a $10 minimum-order policy. You can substitute a number of smaller 10-watt resistors in series to get the equivalent resistance.—*Irwin Math*

PADS FOR THE LAB-QUALITY AUDIO GENERATOR

For anyone who has found it impossible to get certain precision resistors used in the attenuator network of the "Lab-Quality Audio Generator" (RADIO-ELECTRONICS, May 1964), here are three types of pads, with the same attenuation, using standard 1% resistors. Each type is designed to work into 600 ohms, and also to give the generator a load of 600 ohms.

The one shown in Fig. 1 does not give 600 ohms looking back from the load. Both the unbalanced type (Fig. 2) and the balanced (Fig. 3) do provide 600 ohms at either end. If the balanced pad is used, a 3pdt switch is required for S8, as in Fig. 4. The other pads use dpdt switches as shown in the article. All networks are accurate to within 1% of 600 ohms and the necessary attenuation.—*Robert Russell*

[Resistors of the values specified in the original article are made by Aerovox.—*Editor*]

END

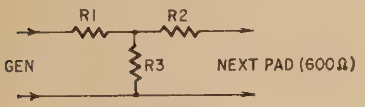


Fig.1

db atten	R1	R2	R3
	(Values in ohms; K = 1,000)		
1	46.4	21.5	5,110
2	51.1	90.9	2,610
4	110	178	1,330
6	261	75	681
10	383	82.5	316
20	511	316 & 3,840 in parallel	100
40	316	27.8K & 820K* in parallel	287

*10% tolerance sufficient

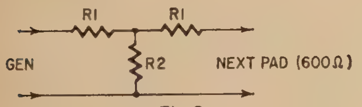


Fig.2

db atten	R1 (ohms) (K = 1,000)	R2 (ohms)
1	34.8 & 3.9K* in parallel	5,110 & 90.9 in series
2	68.1	2,610 & 220K* in parallel
4	121 & 14.7 in series	1,000 & 261 in series
6	100 & 100 in series	825 & 33K* in parallel
10	316 & 20K* in parallel	422
20	464 & 26.1 in series	121
40	562 & 26.1 in series	12.1

*10% tolerance sufficent

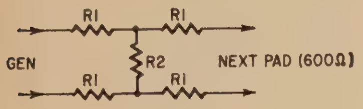


Fig.3

db atten	R1 (ohms; K = 1,000)
1	17.8 & 560* in parallel
2	34.8 & 2.7K* in parallel
4	68.1
6	100
10	162 & 3.3K* in parallel
20	261 & 3.9K* in parallel
40	316 in parallel with 3.9K* & 330* in series

*10% tolerance sufficient. Values for R2 are the same as those in Fig. 2.

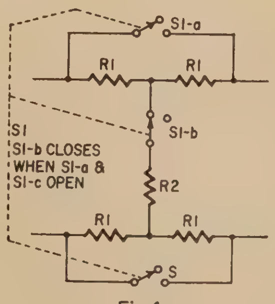


Fig.4

CORRECTIONS

There is a misprint in the calculation in the "Case of the Lost Energy" in the "What's Your EQ?" on page 47 on the August issue. The answer to the first part of the problem is 5,000 μJoules or .005 Joule.

Professor Hughes has called our attention to two errors in his coauthored article "Hi-Fi Pickup Arm—Theory and Practice" in the May 1964 issue. The mounting plate (part A) should be 1⅛ inch wide—not 2⅛ in. as indicated in Fig. 6. It was fabricated from 1/16-in. stock. The ⅛-in. notation is an error. However, this thickness is not at all critical and any convenient sheet stock may be used.

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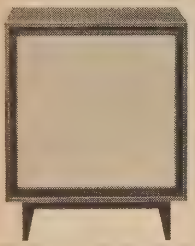

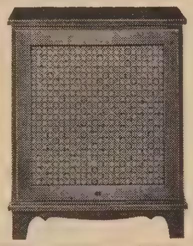

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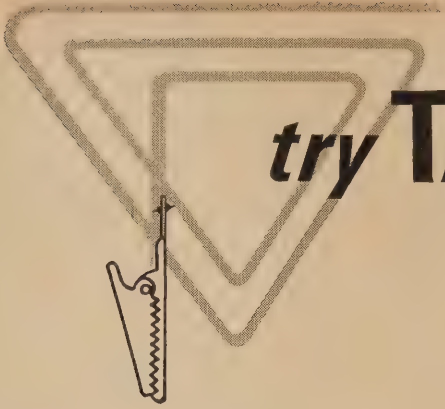


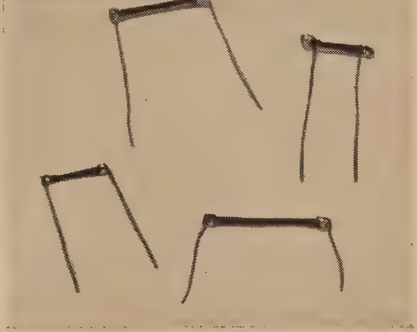
try This one

COLOR-CODING WITH CLIPS

Those plastic paper clips of assorted colors available at stationery stores may be used for marking wires and terminals when replacing defective parts in electronic gear. Clip a colored clip to each wire and terminal to enable you to solder in the new part properly. Even if you accidentally drop one of the clips into circuit wiring, there's no danger of a short circuit.—*John Comstock*

DRAFTING LEAD MAKES TEMPORARY RESISTORS

The photo shows several home-brew resistors of assorted values. They were made by wrapping several turns of No. 20 wire about both ends of a piece of draftsman's lead. I normally use "Eagle Turquoise" brand, but any good grade of automatic-pencil drafting lead should work equally well. After wrapping the wire, solder on the wrapped area.



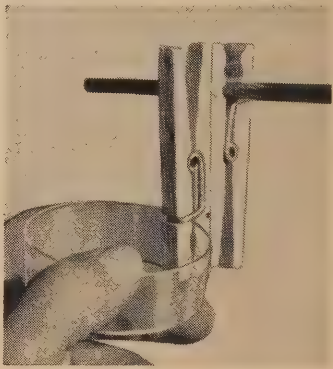
The length of the resistor depends upon the resistance desired. The 3H lead of the brand mentioned measures about 1 ohm per inch. Generally speaking, the softer the grade of lead, the less resistance for given length. The finished product by no means represents the equivalent of a commercial resistor, but these substitutes may be used until you can buy a proper commercial unit.

Use draftsman's lead for its uniform consistency. Common pencil lead is not recommended, since it is likely to have "hot spots" – uneven concentration of graphite in the filler material. Such spots cause the current to follow a low-resistance path within the lead, rather than giving the equal distribution desired.

The power rating of these units is approximately 1/3 watt.—*Roy R. Niehaus, Jr.*

DOUBLE-JAW CLAMP FROM CLOTHESPIN

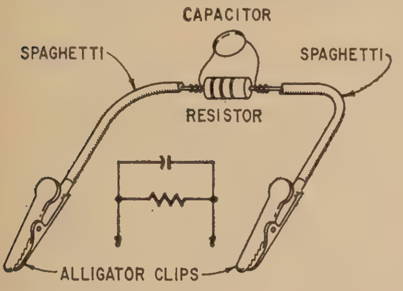
A double-jaw clamp from two spring type clothespins that will be like a third hand can be rigged quickly by gluing two clothespins together, end to end and side by side as shown in the photograph. Use white glue and the two pieces will be cemented permanently. In an emergency, you can fasten the clothespins together by taping or with a rubber band. The clamp is great for holding small articles for soldering, letting paint or glue dry, etc.—*Glen F. Stillwell*



SCOPE INPUT GIMMICK

As you experiment with electronic circuits, you will sometimes find one that refuses to work right unless your scope or vtvm is connected to it, or *not* connected to it. The reason is that the critical circuit is strongly affected by the input impedance of the instrument. Since you can't leave the scope in the circuit full-time, make a substitute for experimenting on the circuit even when the scope is needed elsewhere.

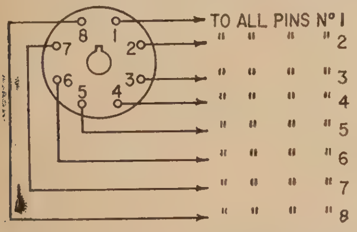
Prepare a gimmick like the one shown here, from a resistor and a ceramic capacitor and two alligator clips. Choose a resistor equal to the resistive part of the instrument's input impedance (usually specified), and a capacitor slightly larger than the capacitive part, to substitute for the absent test leads. —*Tom Jaski*



TUBE CHECKER ADAPTER TESTS OLD TUBES

Many modern tube testers have only octal, loctal, 7-pin and 9-pin sockets. Often, however, one has to test a 4-pin, 6-pin or the like. The situation can be remedied by wiring an octal plug as shown in the diagram.

Then mount a 4-pin, 5-pin, 6-pin, 5-pin nuvistor and a 7-pin nuvistor socket in a small box and wire the leads from the octal socket to them. With this, a tube manual and your tube-tester chart, you should be able to test just about all types with less hard work—just common sense.—*Allan Glaser*



SOLDERING MINIATURE TUBE SOCKETS

After spending many hours wiring a receiver, I found that the tubes would not fit into the sockets, because solder had flowed into the pins of the tube socket itself. Trying to heat the pins and remove the solder proved fruitless.

The only alternative I had was to replace each and every socket, this time taking more care. So that I won't have the same problem again, I now insert an old tube into the socket before soldering.

This will not prevent solder from flowing into the pins of the socket. However, since the solder will not stick to miniature tube pins, any solder flowing into the tube socket pins will just surround the pins. The tube can still be removed without any trouble. What's more, I can put my good tubes back in! —*Loren M. Mitchell*

BLOWN FUSE COIL FORM

Blown fuses of the popular 3AG cartridge type make excellent low-loss forms for miniature rf coils, especially rf chokes. The fuse diameter is ¼ inch, and the end caps are easily soldered to. The desired number of turns should be wound between the two end caps. The result will be a neat rf coil that can be mounted in fuse clips or, if pigtail fuses are used, soldered directly into a circuit.

The required number of turns for a particular inductance can be readily calculated from the simple single-layer inductor formula in the *Radio Amateur's Handbook*, or almost any radio handbook.—*Irwin Math*

GROMMET GIMMICK

To install rubber grommets, bumpers, etc. held in place by forcing the rubber through a hole in a chassis, loop a wire around the narrow part of the grommet, push both ends of the wire through the hole where the grommet is to go, then give the wire a strong tug.

Remove the wire by pulling on one end.—*Harry J. Miller*

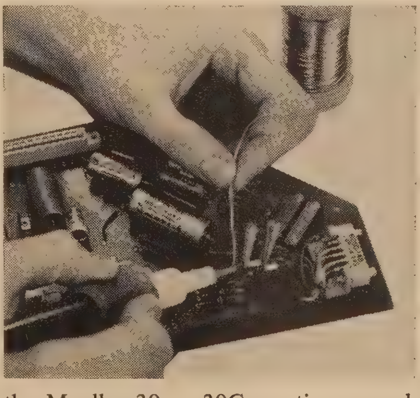
CEILING MOUNTS ROLL-DOWN CHARTS

Here is a novel suggestion that will impress the customer and aid the service technician. At a desired spot in the shop, locate the ceiling rafters. Nail a wide and fairly thick board between two ceiling rafters. On this board, mount hardware for the desired number of extra-long window shades. On these shades cement price lists, charts, and other items you or a customer might want to see.

Label each shade string, so you can find the proper chart or price list at once. —*A. von Zook*

CLIP-ON HEAT SINKS PROTECT DELICATE PARTS

The photo shows miniature alligator clips with felt cemented into their jaws, clipped to the leads of heat-sensitive components on a printed-circuit board. The felt is wetted just before use, and the water absorbs heat. Clips like the Mueller 30 or 30C are tiny enough not to get in the way of even very tight soldering jobs.—*Boeing Airplane Co.*



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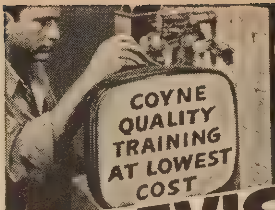
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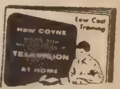

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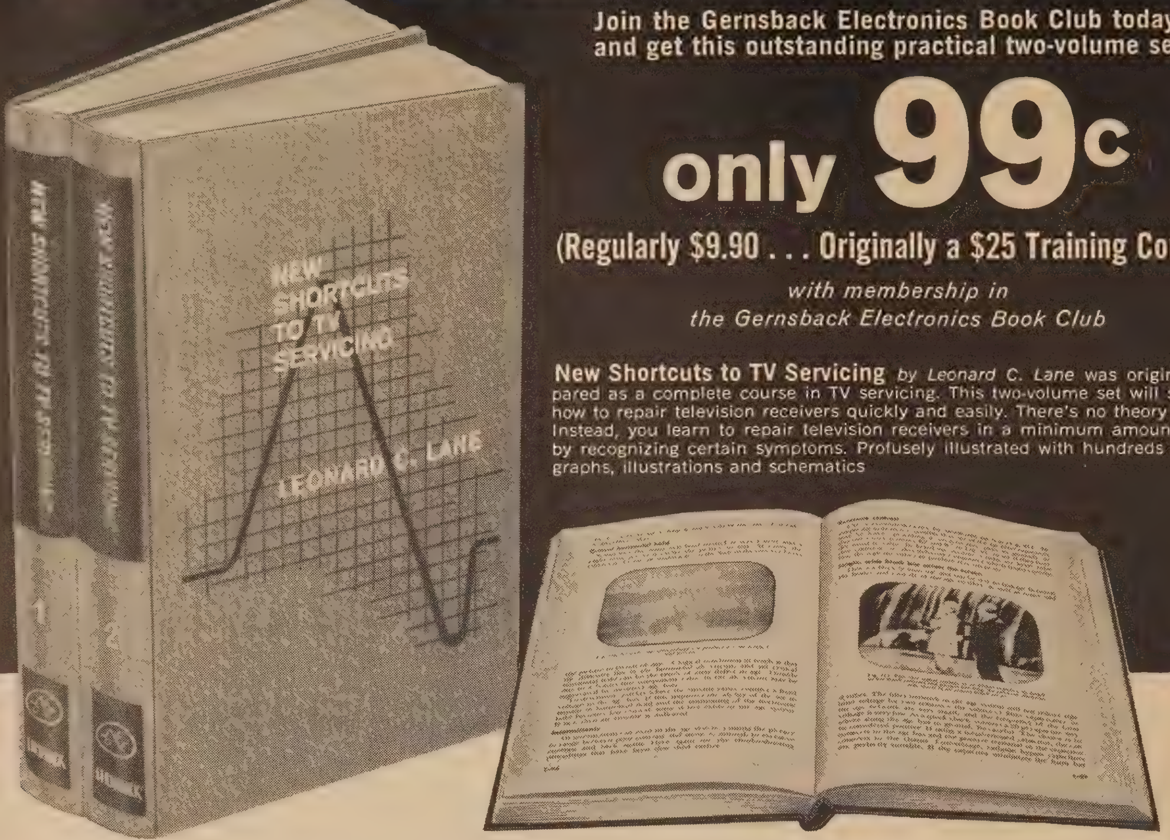

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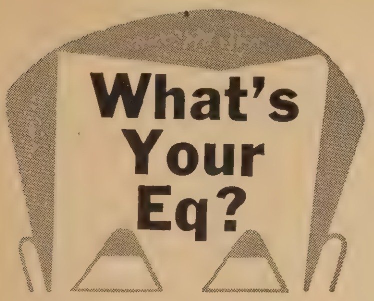
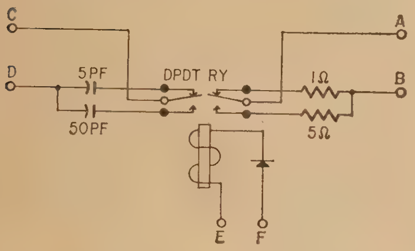


This month's puzzles are on page 59

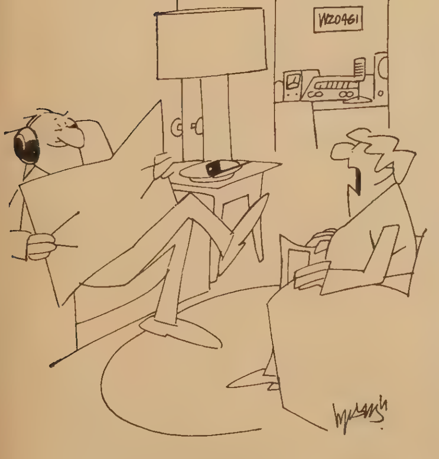
What's in the Box?

After taking the "lid" off of the box, we see two resistors, two capacitors, a dpdt relay and a diode. They are connected as shown in the diagram with relay contacts in the de-energized position.



Reverse Polarity

The vom leads picked up rf from the antenna, which when shunt-rectified by the diodes, resulted in a negative-dc voltage sufficient to overcome the positive 13 volts from the power supply, with 13 volts left over! END



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0A4G	1.35	3GK5	.97	6AL11	2.05	6CM7	.67	6GN8	.92	7C7	1.45	12CT8	1.60	17JZ8	1.98
0B2	.80	3HS8	1.29	6AM8	.76	6CM8	1.60	6GT5	[illegible]	7E7	.95	12CX6	.52	17L6	1.25
0B3	1.20	3Q4	.79	6AN4	3.18	6CN7	.68	6GV5	1.85	7EY6	.73	12D4	.67	18A5	1.54
0C3	.75	3S4	.73	6AN5	1.95	6CQ4	1.35	6GV6	1.85	7F7	1.75	12DB5	1.05	18FW6	.47
0D3	.80	3V4	.61	6AN6	2.45	6CQ7	1.80	6GW6	1.85	7F8	1.75	12DE8	.81	18FX6	.51
0G3	2.75	4AU6	.94	6AN8	1.50	6CQ8	.90	6GW8	1.50	7G7	.95	12DL8	.85	18FY6	.48
0Y4	1.20	4AV6	1.15	6AQ5	.52	6CR6	.58	6GX6	1.10	7H7	1.37	12DQ6	1.02	19AU4	.85
0Z4	.77	4BA6	.85	6AQ6	1.00	6CS6	.55	6GX8	[illegible]	7HG8	1.67	12DQ7	1.33	19BG6	1.35
1A3	.70	4BC5	.95	6AQ7	1.73	6CS7	.67	6GY6	1.10	7J7	1.50	12DS7	.82	19EA8	.77
1A5	.75	4BC8	1.69	6AQ8	1.20	6CU5	.56	6GZ5	1.10	7K7	1.45	12DT5	.74	19HV8	1.44
1A6	.70	4BL8	1.00	6AR5	1.03	6CU6	1.05	6HF5	3.40	7L7	1.45	12DT7	.77	19JN8	1.20
1A7	1.05	4BN6	1.46	6AR6	1.50	6CU8	1.68	6HF8	1.75	7N7	1.25	12DT8	.76	19T8	.83
1AF4	1.30	4BQ7	.99	6AR8	2.00	6CW4	[illegible]	6HG8	1.95	7Q7	1.50	12DW7	1.20	21EX6	1.47
1AG4	1.75	4BS8	1.48	6AR11	1.70	6CW5	1.10	6HJ8	1.45	7R7	1.15	12DY8	1.75	21GY5	1.92
1AX2	.60	4BU8	1.29	6AS5	.59	6CX8	1.82	6HS8	1.45	7S7	1.60	12DW8	.87	22BW3	1.43
1B3	.77	4BZ6	.90	6AS6	1.00	6CY5	.68	6H6	.56	7V7	1.45	12DZ6	.60	22DE4	1.53
1C5	.70	4BZ7	1.56	6AS7	2.75	6CY7	.69	6J4	2.95	7W7	1.45	12EA6	.99	25AK4	.66
1DN5	.53	4CB6	.95	6AS8	1.20	6CZ5	1.80	6JB6	.98	7X6	.95	12EC8	1.38	25AX4	.68
1G3	.77	4CS6	.59	6AS11	1.98	6CZ7	1.95	6JE6	3.25	7X7	1.25	12ED5	.60	25BK5	1.35
1G4	.69	4CY5	1.25	6AT6	.47	6D4	1.75	6JE8	1.50	7Y4	.67	12EG6	.60	25BQ6	1.05
1G6	.80	4DE6	1.19	6AT8	.84	6D6	2.50	6J5M	.92	7Z4	.95	12EK6	.60	25C5	.51
1H4	.69	4DK6	.57	6AU4	.83	6D10	[illegible]	6J6	.69	8AU8	.93	12EL6	.48	25CA5	.57
1H5	1.00	4DT6	.55	6AU5	1.75	6DA4	.66	6J7	1.65	8AW8	.96	12EL8	.86	25CD6	1.50
1H6	.70	4EH7	1.45	6AU6	.50	6DA5	1.28	6J8	1.40	8BQ5	.63	12EZ6	.55	25DK4	1.05
1J3	.77	4EJ7	1.55	6AU7	.54	6DB5	2.30	6J11	1.83	8CG7	.66	12F5	1.50	25DN6	1.40
1J5	.95	4EM6	.94	6AU8	.85	6DC6	1.30	6JH8	1.85	8CM7	.73	12F8	.64	25EH5	.53
1J6	.95	4ES8	1.90	6AV5	1.75	6DC8	1.33	6JZ8	1.85	8CN7	1.00	12FA6	.77	25L6	.55
1K3	.77	4EW6	1.19	6AV6	.39	6DE4	1.18	6K6	.61	8CS7	.77	12FK6	.78	25W4	.66
1L4	.64	4GK5	1.59	6AV11	1.65	6DE6	.59	6K7	.95	8EB8	.97	12FM6	.48	25Z5	.79
1LA4	1.30	4GM6	.59	6AW8	.88	6DE7	1.33	6K7G	.75	8EM5	.59	12FR8	.95	25Z6	.79
1LA5	2.50	4GS8	1.29	6AX3	1.05	6DG6	.60	6K8	1.45	8FQ7	.54	12FX5	.94	27GB5	1.59
1LA6	1.45	4GZ5	1.49	6AX4	.64	6DJ8	1.17	6K11	1.50	8GN8	1.58	12FX8	.88	32ET5	.53
1LB4	1.80	4HM6	1.00	6AX5	.73	6DK6	.57	6KD8	.99	8JV8	1.10	12GC6	1.04	32L7	1.50
1LC5	1.25	4HS8	1.10	6AX7	1.25	6DN6	1.50	6L5	.90	9A8	1.60	12GE5	1.44	33GY7	2.99
1LC6	1.80	4HT6	.99	6AX8	1.45	6DN7	1.35	6L6G	1.45	9AU7	1.19	12J5	.75	34GD5	.79
1LD5	1.95	4JC6	1.64	6AY3	1.08	6DQ5	3.10	6L6GC	1.55	9BR7	1.32	12J8	.82	35B5	.95
1LE3	1.50	4JD6	1.64	6AZ8	2.19	6DQ6	1.05	6L6-M	1.95	9CL8	.77	12K5	.73	35C5	.49
1LG5	1.95	5AM8	.77	6B4	3.80	6DR7	1.47	6L7	1.05	9U8	1.30	12K8	3.00	35EH5	.84
1LH4	1.25	5AN8	.88	6B10	1.39	6DS4	1.40	6M11	1.85	10C8	1.64	12L6	.71	35L6	.58
1LN5	1.25	5AQ5	.52	6BA3	1.15	6DS5	1.30	6N6	1.45	10DE7	1.35	12L8	.50	35W4	.40
1N5	1.20	5AS8	1.75	6BA6	.48	6DT5	.79	6N7	.98	10EG7	1.75	12Q7	.75	35Z5	.58
1Q5	.95	5AT8	.81	6BA7	1.50	6DT6	.51	6P5	.95	10EM7	1.75	12R5	1.18	36AM3	.78
1R4	.80	5BE8	1.27	6BA8	1.50	6DT8	.92	6Q7-GT	.98	10GN8	1.45	12SA7	1.25	50A5	1.70
1R5	.75	5BK7	.84	6BC4	2.10	6DV4	2.65	6Q7-M	1.45	10JA8	1.30	12SC7	.78	50B5	.67
1S4	1.15	5BQ7	.99	6BC5	.59	6DZ4	1.85	6R7	.90	11CY7	.73	12SF7	.87	50C5	.51
1S5	.73	5BR8	.81	6BC7	1.47	6E5	1.85	6S4	.49	12A4	.59	12SG7	.87	50DC4	.71
1T4	.70	5BW8	1.31	6BC8	1.00	6EA7	1.50	6S7	.90	12A5	.95	12SH7	.79	50EH5	.53
1T5	.80	5CG8	.79	6BD6	.95	6EA8	.77	6S8	1.15	12A6	.55	12SJ7	.75	50HC6	.86
1U4	.57	5CL8	.74	6BE3	1.15	6EB5	.71	6SA7GT	.97	12A7	1.45	12SK7GT	.93	50L6	.59
1U5	.63	5CQ8	.82	6BE6	.53	6EB8	.90	6SA7-M	1.25	12A8	3.00	12SK7	1.25	50Y6	.95
1V	1.05	5DJ4	1.01	6BF5	.88	6EH5	1.33	6SB7Y	1.15	12A11	1.74	12SL7	.78	50Y7	1.25
1V2	.70	5EA8	.79	6BF6	.42	6EH7	1.56	6SC7	1.35	12AB5	.58	12SN7	.65	117L7	3.95
1X2B	.80	5EU8	.79	6BF8	1.70	6EH8	1.49	6SD7	.70	12AC6	.53	12SQ7	.89	117N7	3.95
2A3	1.25	5EW6	1.10	6BG6	1.65	6EJ7	1.47	6SF5	.75	12AD6	.55	12SR7	.98	117Z3	.83
2A5	1.25	5GH8	1.52	6BH6	1.00	6EM5	.75	6SF7	1.00	12AE6	.48	12U7	.60	22	.95
2A6	1.10	5GM6	1.04	6BH8	.94	6EM7	.80	6SG7	.85	12AE7	.92	12V6	.62	24A	.95
2A7	1.50	5GX6	1.00	6BJ6	.63	6EQ7	1.12	6SH7	.95	12AF3	.71	12W6	.69	26	1.10
2AF4A	.93	5HC7	1.49	6BJ7	.77	6ER5	1.65	6SJ7GT	.86	12AF6	.65	12X4	.45	27	1.50
2AH2	1.23	5HG8	1.85	6BJ8	1.45	6ES5	1.40	6SJ7-M	.95	12AG6	1.50	13DE7	1.24	28D7	1.50
2AS2	1.25	5J6	.70	6BK4	3.39	6ES8	2.79	6SK7GT	.92	12AJ6	.60	13EM7	1.95	30	1.15
2B3	.98	5T4	1.00	6BK5	1.50	6EU7	1.15	6SK7-M	1.25	12AL5	.45	14A4	.98	32	1.00
2B7	.70	5T8	.84	6BK7	.84	6EU8	.77	6SL7GT	.85	12AL8	.93	14A5	1.10	33	.85
2BN4	.95	5U4	.59	6BL7	1.05	6EV5	.73	6SN7	.82	12AQ5	.58	14A7	1.10	34	.79
2CY5	.95	5U8	.82	6BL8	1.53	6EW6	.55	6SQ7	.92	12AT6	.48	14AF7	1.10	35-51	.85
2D21	.70	5V3	1.59	6BN4	1.00	6EW7	2.40	6SR7	1.00	12AT7	.74	14B6	1.20	36	.95
2ER5	1.65	5V4	1.45	6BN6	.73	6EY6	.73	6SS7	.95	12AU6	.49	14B8	1.10	37	.70
2FS5	1.47	5V6	.55	6BN8	1.15	6EX6	3.65	6SZ7	.95	12AU7	.59	14C5	.98	38	.90
2GK5	1.85	5W4	.95	6BQ5	.95	6EZ5	1.55	6T4	.95	12AV5	1.30	14C7	.98	39/44	.85
2GW5	2.40	5X4	.90	6BQ6/ 6CU6	1.05	6EZ8	1.84	6T8	.84	12AV6	.39	14E6	.98	41	.95
2X2	.60	5X8	.80	6BQ7	.98	6FA7	1.32	6U5	2.25	12AV7	.80	14E7	.98	42	[illegible]
2X2A	1.30	5Y3	.45	6BR8	1.44	6FD7	2.37	6U8	.81	12AW6	.98	14F7	1.20	43	1.20
3A2	1.55	5Y4	1.25	6BS8	[illegible]	6FJ7	1.79	6V3	1.75	12AX3	1.04	14F8	1.20	45	2.00
3A3	.74	5Z3	1.00	6BU8	.68	6F5	.95	6V4	.59	12AX4	.65	14H7	.95	46	.95
3A4	.74	5Z4	1.40	6BV8	1.23	6F6	1.15	6V6GT	.52	12AX7	.61	14J7	1.30	47	2.10
3A5	1.10	6A3	2.50	6BW8	1.35	6F6M	1.25	6V6M	2.50	12AY7	1.42	14N7	.98	48	3.50
3AF4	1.50	6A4	.80	6BX7	1.07	6F7	2.50	6W4	.60	12AZ7	.84	14Q7	1.25	50	1.45
3AL5	.44	6A6	1.50	6BY5	2.25	6F8	1.25	6W6	.69	12B4	.66	14R7	.98	53	2.95
3AT2	1.25	6A7	2.25	6BY6	1.05	6FG5	2.15	6X4	.39	12BA6	.65	14S7	1.45	55	1.90
3AU6	.52	6A8M	1.45	6BY8	1.07	6FG7	.67	6X5	.75	12BA7	1.30	14W7	.98	56	.95
3AV6	.40	6AB4	.45	6BZ6	.54	6FG8	.65	6X8	.78	12BD6	.48	14X7	.95	57	1.35
3B2	3.45	6AB5	3.00	6BZ7	.99	6FJ5	2.25	6Y6	1.25	12BE3	1.39	14Y4	.95	58	1.25
3B7	1.35	6AB7	1.00	6BZ8	1.60	6FM7	1.50	7A4	1.15	12BE6	.51	15AF11	1.95	59	2.00
3BA6	.95	6AC5	1.95	6C4	.43	6FQ7	1.05	7A5	.95	12BF6	.58	15CW5	1.15	71A	.95
3BC5	.61	6AC7	.91	6C5	1.40	6FS5	1.35	7A6	1.15	12BH7	.75	15FY7	1.29	75	1.90
3BE6	.90	6AD7	3.25	6C6	2.00	6FV6	1.49	7A7	1.15	12BK5	.98	15HB6	1.28	76	1.40
3BN4	1.19	6AF3	1.10	6C8	3.25	6FV8	.77	7A8	.66	12BL6	.54	16AQ3	1.42	77	1.25
3BN6	.73	6AF4	.99	6C10	1.55	6FW5	1.96	7AD7	1.15	12BN6	1.45	17AX3	1.65	78	1.15
3BU8	.76	6AF4A	.99	6CA4	.95	6FW8	4.25	7AF7	1.15	12BQ6/ CU6	1.09	17AX4	.65	80	1.25
3BY6	.56	6AF11	1.98	6CA5	1.39	6FY5	1.25	7AG7	1.15	12BR7	.72	17BE3	1.84	81	1.25
3BZ6	.54	6AG5	.68	6CB5	3.75	6G5	2.50	7AH7	.95	12BV7	.74	17BQ6	1.04	83	1.75
3CB6	.54	6AG7	1.10	6CB6	.53	6G6G	1.00	7AU7	.63	12BW4	1.09	17C5	2.35	84/6Z4	.95
3CE5	.90	6AH4	.79	6CD6	1.45	6GE5	1.65	7B4	1.05	12BY7	.75	17DE4	1.29	85	.98
3CF6	1.05	6AH6	1.05	6CF6	.95	6GF5	1.75	7B5	1.45	12BZ6	.84	17DM4	1.22	5881	2.95
3CS6	.56	6AJ5	1.95	6CG7	.59	6GH8	.78	7B6	1.25	12BZ7	.84	17DQ6	1.04	6146	3.95
3CY5	1.20	6AJ8	1.73	6CG8	.78	6GK5	.59	7B7	1.95	12C5	.56	17DQ7	1.85	6336	5.95
3D6	1.45	6AK5	.90	6CL6	1.69	6GK6	.77	7B8	.95			17GE5	1.70	6550	3.75
3DG4	.83	6AK6	.94			6GL7	2.35					17GV5	1.73	807	.70
3DK6	.58														

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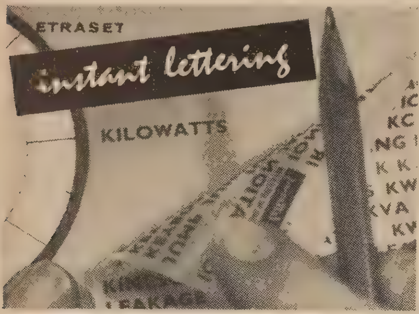

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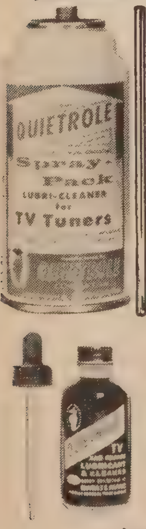

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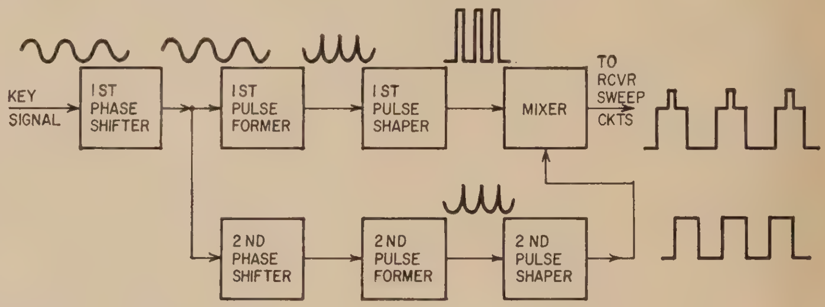
PAY-TV DECODER

PATENT No. 3,116,363

Helias Doundoulakis, Brooklyn, N.Y. (Assigned to Teleglobe Pay-TV System, Inc., New York, N.Y.)

In this system, the transmitter sends normal video and audio signals, with the exception of the horizontal sync pulses, which are replaced by sine waves of controlled frequency. A decoder box, placed between the TV antenna and receiver, converts these key sine waves into sync pulses and permits normal reception. The decoder becomes operative when a coin is inserted or when predetermined signals are received over the telephone line.

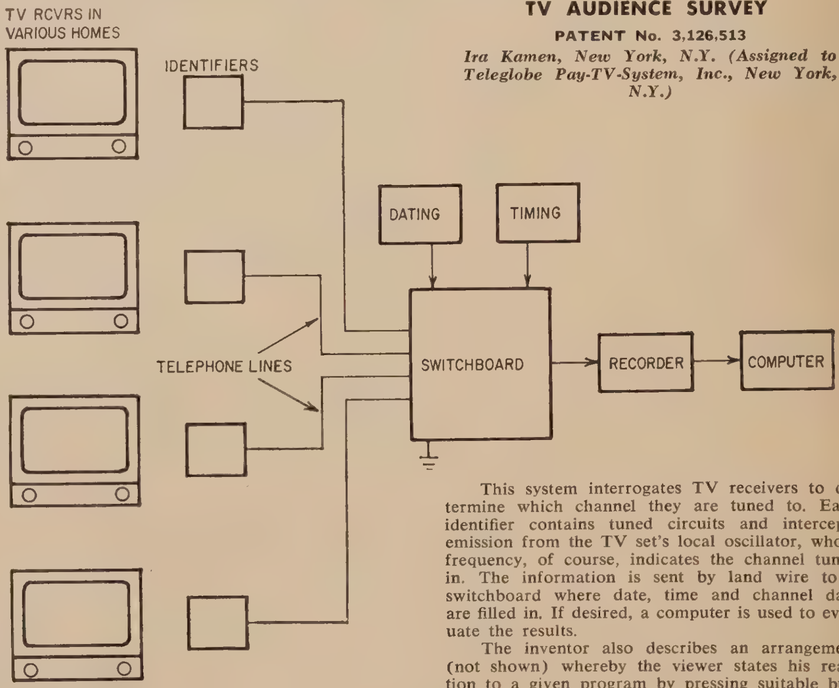


The diagram shows how the received key signal is shifted and shaped to build the sync and blanking signal properly. The mixer output is a conventional horizontal sync pulse.

TV AUDIENCE SURVEY

PATENT No. 3,126,513

Ira Kamen, New York, N.Y. (Assigned to Teleglobe Pay-TV-System, Inc., New York, N.Y.)



This system interrogates TV receivers to determine which channel they are tuned to. Each identifier contains tuned circuits and intercepts emission from the TV set's local oscillator, whose frequency, of course, indicates the channel tuned in. The information is sent by land wire to a switchboard where date, time and channel data are filled in. If desired, a computer is used to evaluate the results.

The inventor also describes an arrangement (not shown) whereby the viewer states his reaction to a given program by pressing suitable buttons on his TV.

FM STEREO

PATENT No. 3,122,610

Antal Csicsatka, Utica, N.Y. (Assigned to General Electric Co.)

This is one of the patents on which modern FM stereo is based. It packs all signals on a single FM carrier, and is compatible with mono. Separate microphones (left and right) deliver sound to a matrix which supplies L + R and L — R. The first component is combined with a 19-kc pilot frequency. Both are frequency-modulated on a carrier (around 100 kc) which, after multiplication, becomes the transmitted FM carrier.

The L — R component is amplitude-modulated on a 38-kc subcarrier, which is suppressed, leaving only the sidebands. Various time delays are inserted to assure that the components will reach the main FM modulator at the proper instant.

A source feeds in commercials and background music if desired.

At the receiver the circuits are conventional until after the discriminator. The pilot frequency is recovered and doubled to supply the missing subcarrier for demodulating L — R. The sidebands are transmitted through a bandpass filter to the detector.

L + R and L — R both enter the matrix circuit, and separate L and R components emerge to feed corresponding amplifiers and speakers. In a mono receiver, only the L + R is utilized. Since it represents the output of both left and right microphones, it is a complete, natural pickup.

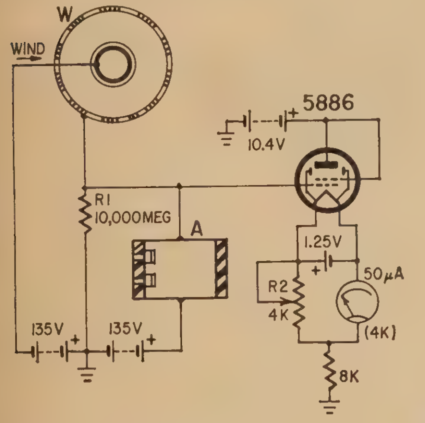
The description of the system is illustrated by eight schematic and block diagrams.

NUCLEAR ANEMOMETER

PATENT No. 3,109,098

Abraham E. Cohen, Wanamassa, N. J. (may be manufactured or used by US Government without royalty payment)

This device measures wind speed. Wind chamber W is two concentric spheres, with the outer one perforated to let air pass. The inner sphere is coated with radium 266 or other isotope to ionize the air. Auxiliary chamber A is equipped with baffles to minimize passage of air through it, but it, too, ionizes the air within it.



The polarized electrodes of each chamber attract ions which flow (in opposite directions) through R1. If wind blows through W, it removes some of the ions and changes the voltage across R1 proportionately.

V is an electrometer which detects the weak voltage across R1. With zero voltage, R2 is set to balance out the meter deflection.

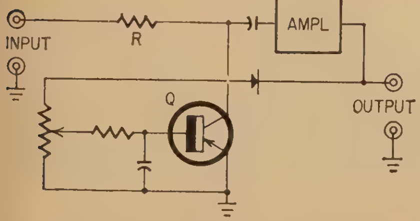
Temperature or altitude changes affect air pressure, so they introduce errors. Since they affect W and A equally, however, they are balanced out. The wind affects W alone.

AUTOMATIC LEVEL CONTROL

PATENT No. 3,117,287

Lawrence N. Damico, E. Boston, Mass. (Assigned to Raytheon Co., Lexington, Mass.)

Q and R form a voltage divider across the amplifier input. Rectified output from the amplifier controls Q's resistance, in the shunt leg of the divider. Greater output means lower resistance, and less signal delivered to the amplifier. Therefore, Q tends to maintain an average output from the amplifier.



The gain of the amplifier itself remains constant. This reduces the possibility of introducing noise or distortion in the amplifier. END

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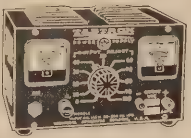

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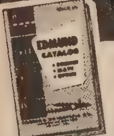

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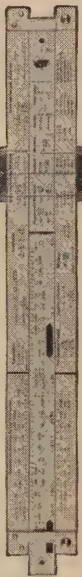

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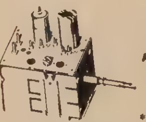

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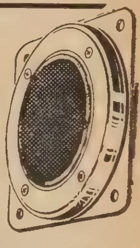

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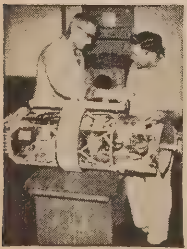

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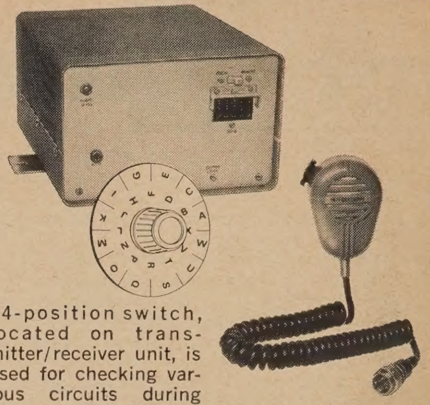

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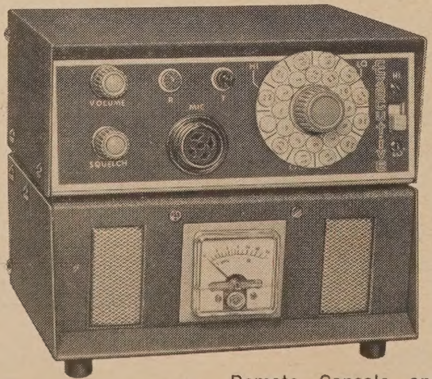

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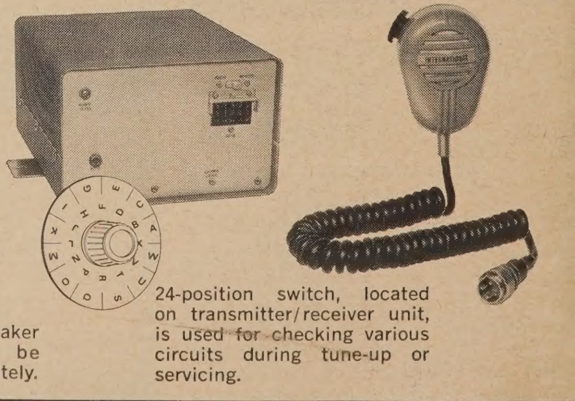

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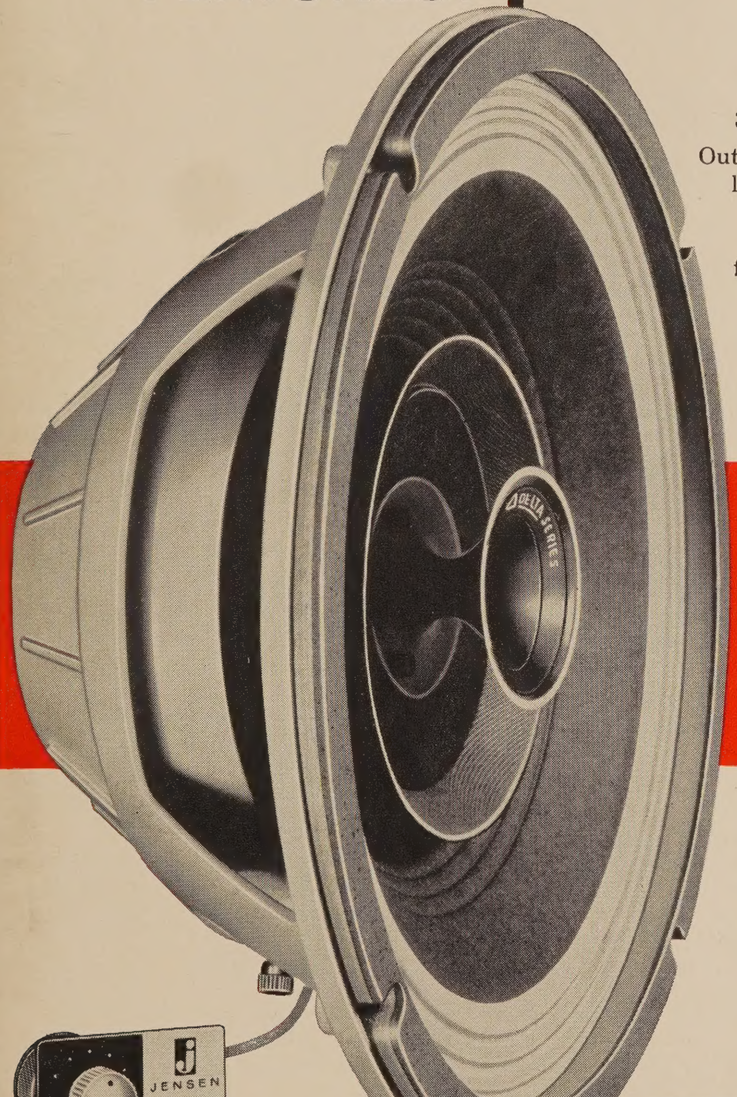

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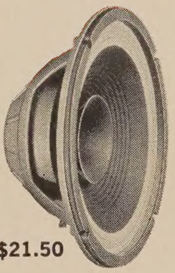

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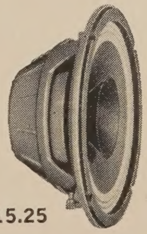

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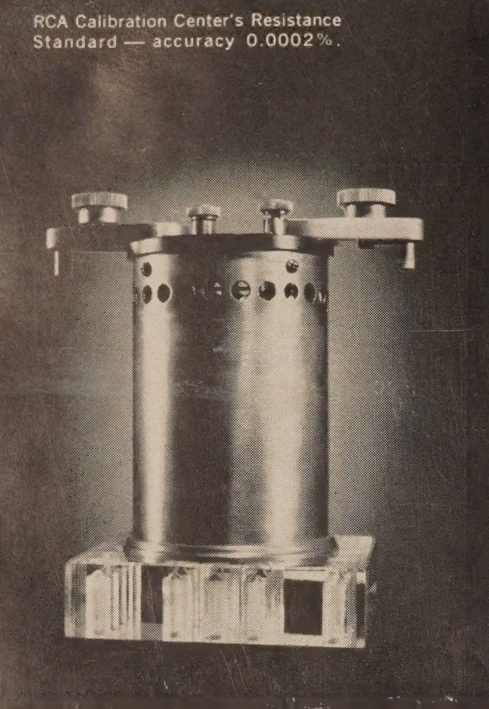
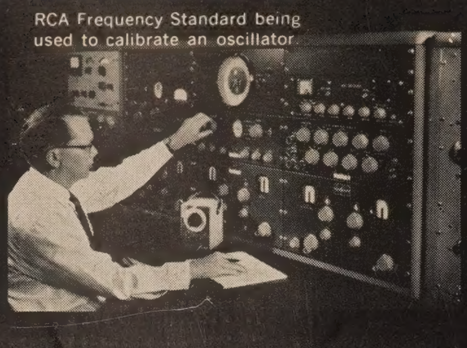
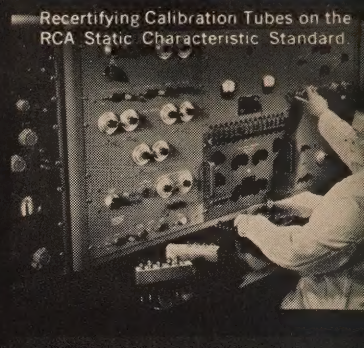


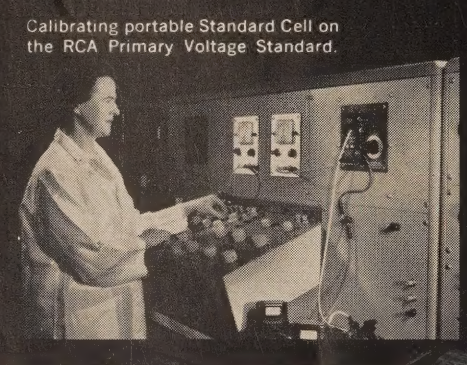
RCA Calibration Center's Resistance Standard — accuracy 0.0002%.



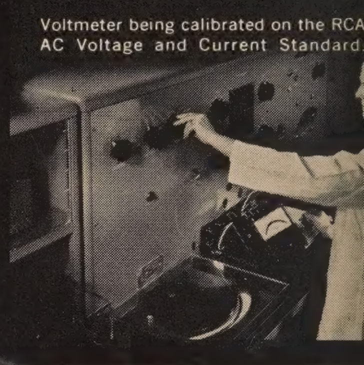
RCA Frequency Standard being used to calibrate an oscillator.



Recertifying Calibration Tubes on the RCA Static Characteristic Standard.

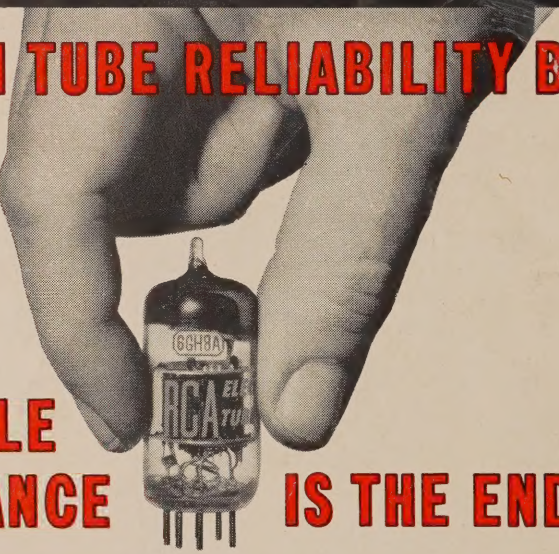


Calibrating portable Standard Cell on the RCA Primary Voltage Standard.



Voltmeter being calibrated on the RCA AC Voltage and Current Standard.

RCA ELECTRON TUBE RELIABILITY BEGINS HERE



DEPENDABLE PERFORMANCE IS THE END RESULT

No reliability program for receiving tubes can be better than the test instruments and equipments it employs.

That's why RCA maintains the extensive Calibration Center in its Harrison, N. J., tube manufacturing plant (see photos above). The Center's responsibility: to assure that all measuring instruments and equipments, used in tube development from initial design through volume production, are accurate within rigidly specified limits. Here is how this is accomplished:

1 The Calibration Center's own equipments are calibrated by standards (voltage, resistance, capacitance, frequency) whose values are regularly checked against standards of the National Bureau of Standards.

2 Measuring instruments used in all research, design, development and application laboratories are calibrated directly from the Center's equipments.

3 Sets of Calibration Tubes, selected to cover every type and family of tubes, are measured in the Calibration Center and used by the Center's personnel to periodically verify the accuracy of all factory tube-testing equipments.

4 Sets of Control Tubes, evaluated under the supervision of the Calibration Center, constantly monitor the repeatability of factory tube-testing equipments.

Our Harrison Calibration Center is another example of the effort we make to assure the specified and dependable performance of every receiving tube that bears the emblem of RCA... performance that benefits you through customer satisfaction.

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FOR TOP-QUALITY
RCA RECEIVING TUBES**

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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